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Engine Frame and Cylinder Tools—II.

By HERMAN LANDRO.

AT THE WHEELOCK ENGINE SHOPS, WORCESTER, MASS.

In considering any special tool problem, the designer is met at the outset by conflicting interests of shop and check book. The shop demands the tool which can best and quickest perform the work; the check book demands with a still small voice (which is none the less mighty because it is no louder than the scratch of the treasurer's pen as he signs his valuable autograph) that the proposed new tool be built for the fewest dollars which real economy permits. The designer takes his head in both hands, and fixes one eye on the machine shop requirements and the other on the cash book, and meditates with a divided soul. Happy, indeed, is he if his conclusions are such that when his travail is over and done, and the new tool stands on the floor at work, his own judgment of its performance tells him that *it* lacks no essential, and includes no needless part; that efficiency has not been sacrificed to a mistaken conception of the real economy of the case, nor has needless cost marred the fitness of the tool for its work.

With an established manufacture of small size, the problem is shorn of many perplexities. In the case, for instance, of the bed of a sewing machine to be thousands and even millions of times duplicated, the utmost efficiency is the one aim to be considered; every cut in the piece can have its own spindle—*must* have its own spindle, and the designer is free to exercise his mind solely in arranging his details to handle the work from one tool to another in the shortest possible time; to make as many of the operations as possible simultaneous, and to insure absolute duplication in the finished work.

In the case of an engine cylinder, the problem is altogether different. There is the cylinder to bore, counterbore, and face. If of the Corliss type, there are four valve seats to be bored at right angles to the cylinder bore, and the valve cap seats to finish, and these five hollow cylinder cuts are to be made in different places for each of the many variations in cylinder diameter and length demanded. It is easily possible to bore the cylinder and all four of the valve seats at once; if this is done the valve seats will be finished long before the main cylinder bore is made, and hence a considerable portion of the elaborate multi-spindle boring machine must be idle a great part of the time. If each of the four valve seats can be bored and faced in one-fourth of the time required for boring and facing the main cylinder, then nothing is gained by the use of more than two boring bars, one for the cylinder, and one to bore the valve seats; and this case might easily happen when the bore of the cylinder was sufficiently small in proportion to its length. Again, with a very short cylinder it might be a great saving of time to have five spindles, and bore all of the five holes at once. At this stage of preliminary investigation, the cylinder tool maker has a distinct vision of a protean type of cylinder boring machine, a changeful creature, which shall be a one, two, three, four or five-spindle tool, as best fits the particular job put before it; as the various elements of such a various machine glide silently in review before his fancy's eye, he sees clearly that the parts of such a tool should be cheap to avoid idleness of investment, and if cheap needfully simple; and if the machine is to be changed to suit each individual job, which means that it is to be erected wholly or in part afresh for every change in its work, then it must not only be cheap in cost of individual parts, but very quickly pulled apart and put together; and these correct premises open up a wide field for investigation. How this field was ploughed at the Wheelock shops by John Wheelock himself, and what he harvested from his labors therein, is clearly enough shown in the engravings and text which follow.

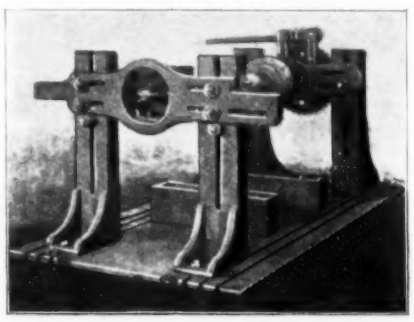


Fig. 1.

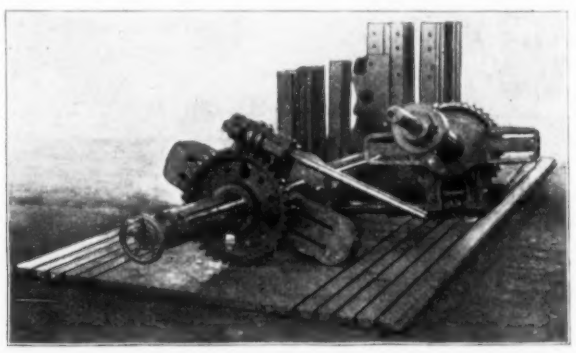


Fig. 2.

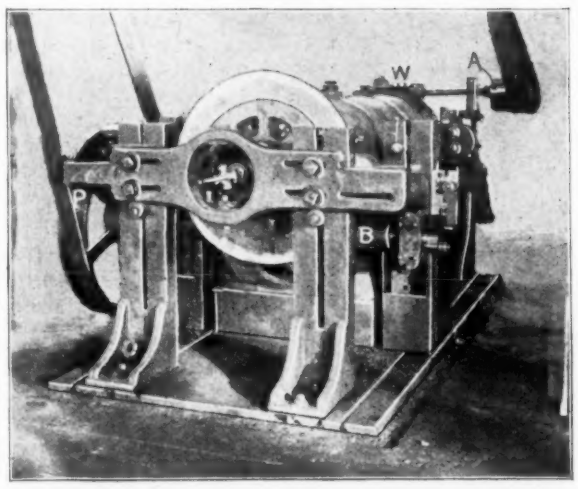


Fig. 3.

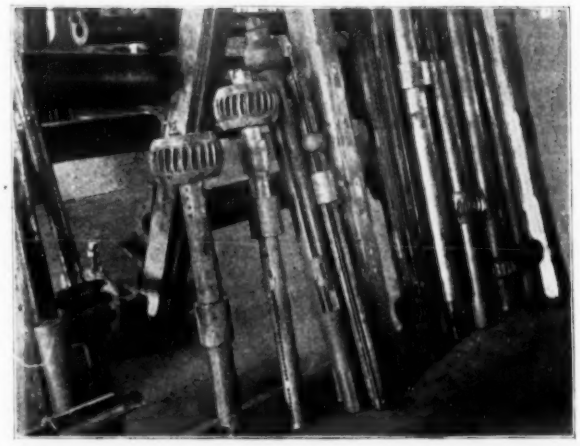


Fig. 4.

CYLINDER BORING.

With a structure which is to be pulled apart and put together almost daily, and to have its actual dimensions varied continually, long and closely-fitted journals would entail a constant delay and annoyance. With such a machine the points at which power is delivered to the boring bars must vary greatly, and hence the power transmission may very well be had through small, light and quick running parts. Globe journals for the boring bars would seem to meet the needful support conditions, and a worm drive gives a quick-belted prime mover, which meets the power delivery problem. Given these two ideas of globe journals and worm driving, and the whole scheme very quickly develops itself into the form shown in Fig. 1 for the main bar and its support.

First a substantial, planed sole plate, suitably T-grooved to take the holding bolts, large enough in surface dimensions and depth to give room and reliable foundation support, is set so that the bottoms of the T-grooves just clear the shop floor. Slotted uprights with bracketed feet are secured at any desired point by ample bolts sliding in the T-grooves of the sole plate. These uprights are in turn provided with vertical grooves for bolts which retain the horizontally slotted crossheads carrying seats for the boring bar journals at any needed hight above the top of the sole plate. The boring bars with their driving end journals in place are shown in Fig. 2, precisely as the machine appears in its "knock down" condition. Beyond the bars in Fig. 2 stand the uprights, long and short, for the cylinder and valve seat boring bars, all on the flat T-grooved sole plate. So simple and quickly handled are these parts that I saw them changed from Fig. 2 to Fig. 1 inside of 25 minutes with not the quickest means of handling. With air hoists as shown in the Rhode Island Locomotive Shops cylinder tools engravings, the work could have been done in much less than that time. Fig. 3 shows the mill at work boring one of the valve chambers and facing the ends of the cylinder, which is referred to in Mr. Hill's Fig. 10. It will be observed that the valve chamber boring bars are driven by pulleys direct, while the main bar is driven by a worm gear; this combined method of driving makes it easy to take the power for all the spindles from one countershaft in a plane at right angles to the cylinder axis. Fig. 3 is the best view obtainable as the machine stands. *B* is the valve boring bar driven by the large pulley *P*. *W* is the main bar driving worm driven by the small belt pulley *A*, Fig. 3.

Fig. 4 shows the light bars for the valve seats standing against the other side of the same rack.

The valve seat bars are all for boring tapers to suit the well-known valve seat construction of the Wheelock engine, so built that the whole valve seat can be removed bodily from the cylinder and replaced with great ease.

These small boring bars, Fig. 4, are very peculiar in having the worm gear cut in the surface of the globe journal, which makes a very easy and simple construction; the cross bar and cap are so made as to confine the globe end of the bar and the driving worm, or to release both, by turning a couple of nuts on the holding bolts; nothing more simple could be had. The whole of this work is so fully shown by the engravings that it need not be enlarged upon. The globe worm gears are in some cases made of wrought-iron, and in some cases of bronze. On one of the old drawings the worm globe is specified as "charcoal iron," a legend of olden time indeed. Whether charcoal wrought, or charcoal gray iron, is not specified, but I believe it was wrought-iron that was intended.

No cylinder boring was in progress the day I was at the Wheelock shops, and I did not have the valve-boring bars put in place for Fig. 1, as they would have confused the small scale engraving. They are, however, very easily and quickly put in any desired position. There are two of these sole plates adjacent to each other in the floor of the Wheelock shops, which should give capacity for a very considerable output.

Fig. 6 is from a blue print construction sheet of a valve seat bar for taper boring, the taper being obtained by shifting the center at one end of the bar. This drawing

is so full and clear as to need no detailed description. It will be observed that the globe journal is used. It is an element of this construction of taper bar with shifting center that the per foot taper is an uncertain quantity. The shifting center can never be put twice in the same place without something more than is shown in these drawings to locate it, with any assurance of the result. Because of this it has been supplanted by the construction shown in Fig. 7, in which the bar rotates on fixed centers, and has always the same axis. The taper is obtained by sliding the tool block along a dovetailed way planed in the side of the bar, and is inevitably exactly that called for by the inclination of the way to the axis of the bar. The details given in Fig. 7 are ample for the production of this bar, and do not require detailed description. It will be noticed that the double-end globe journal is indicated.

Fig. 8 is a construction sheet of a larger bar, and shows a 3-tool boring head, which has the peculiarity of hinged tools, which drop back out of cut if the bar rotation is reversed. In this example babbitt lining is indicated for the globe bearing, and the wearing surface is of limited extent.

The support of a boring bar must be good; if not, a crooked bore or an unintentionally tapered bore may result. There is nothing in the general scheme of the Wheelock boring tools which *need* entail any uncertainty of result; if the boring bar journals remain unchanged through the cut, the results with bars shown in Figs. 7 and 8 must be good. The bar shown in Fig. 6 is objectionable only because it is difficult to adjust a shifting center bar twice *exactly* alike. For this reason Fig. 7 is far the better taper boring bar construction. Of course, no bar with a faulty journal support can ever give duplicate results. The hinged boring tool feature is a novelty to me, and I cannot therefore speak of its advantages. It is not a common feature, and is, of course, open to the objection of uncertain position, which follows as soon as a part is made movable.

The Wheelock cylinder tools afford a valuable study in boring bars, and there is surely no radical objection to this general plan of boring mill, except that at every setting reliance must be placed on the care of the workman who puts the bars in place. It i

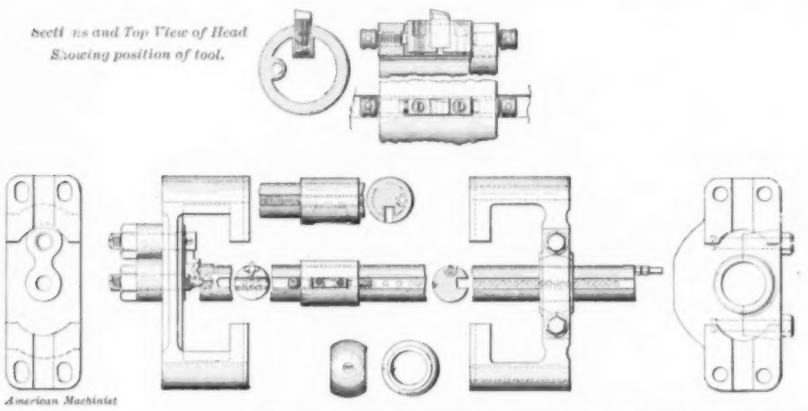
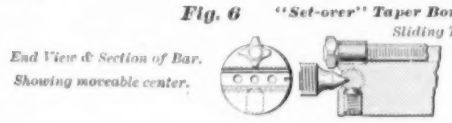


Fig. 6 "Set-over" Taper Boring Bar. Whitlock Engine Shops



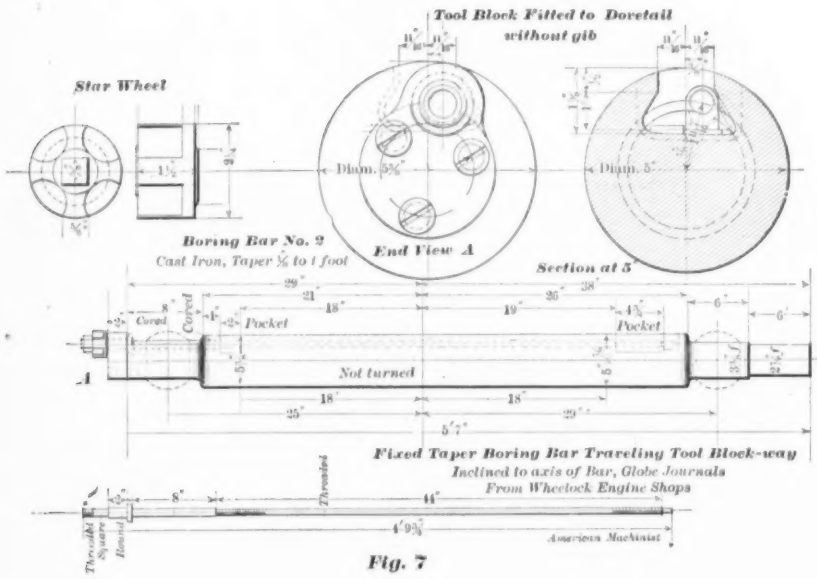
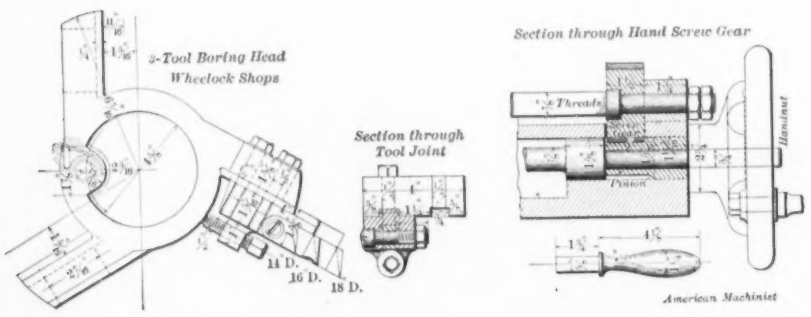

Tool Block Fitted to Dovetail without gib
Star Wheel
Boring Bar No. 2
Cast Iron, Taper ⅛ to 1 foot
End View A
Section at 5
Not turned
Pocket
Fixed Taper Boring Bar Traveling Tool Block-way
Inclined to axis of Bar, Globe Journals
From Wheelock Engine Shops
American Machinist

Fig. 7



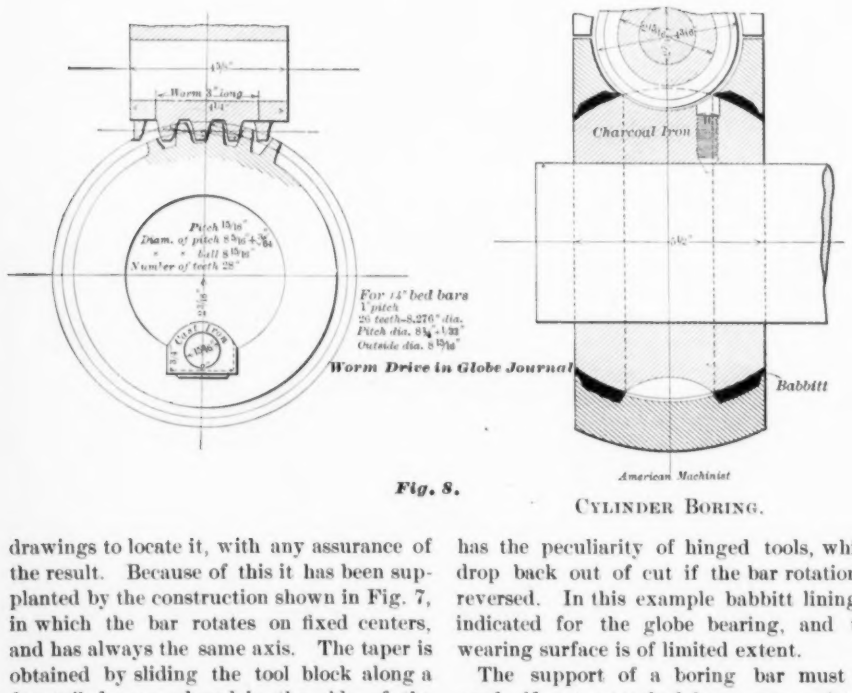


Fig. 8.

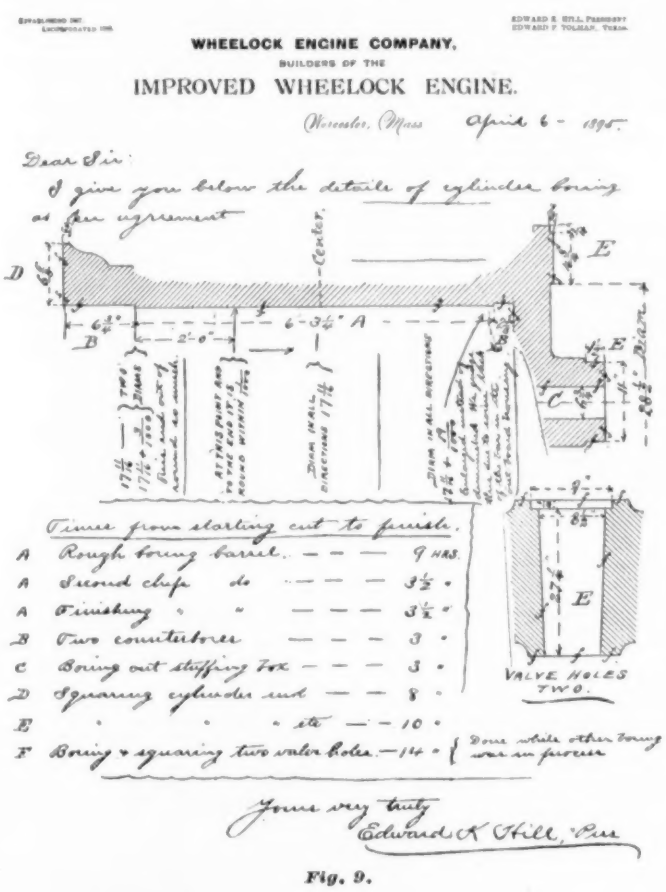

WHEELOCK ENGINE COMPANY,
BUILDERS OF THE
IMPROVED WHEELOCK ENGINE.
Worcester, Mass April 6 - 1895.
Dear Sir:
I give you below the details of cylinder boring as per agreement
Times from starting cut to finish.
A Rough boring barrel. — — — 9 HRS.
A Second chips do — — — 3½ "
A Finishing " " — — — 3½ "
B Two counterbores — — — 3 "
C Boring out stuffing box — — — 3 "
D Squaring cylinder end — — — 8 "
E " " " etc — — 10 "
F Boring + squaring two valve holes — 14 " { Done while other boring was in process
Yours very truly
Edward K. Hill, Pres.
VALVE HOLES TWO.

Fig. 9.

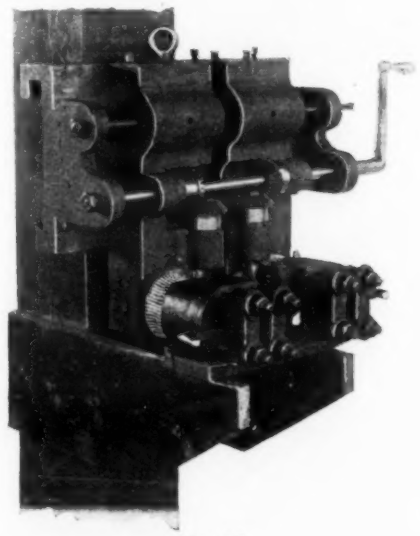
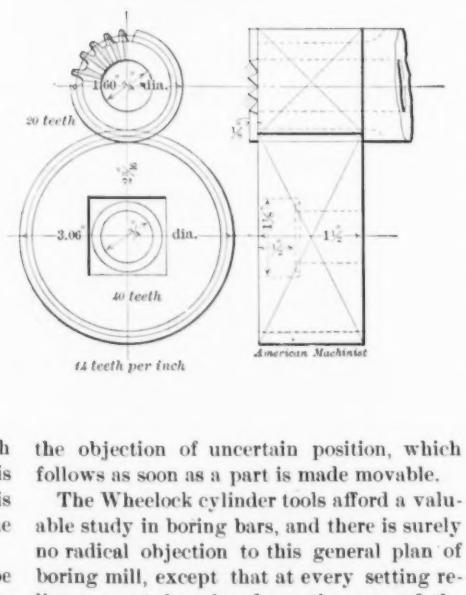


Fig. 10.



CYLINDER BORING.

Upon reflection, a number of questions regarding this general scheme of cylinder boring, made me decide to delay this article until I had inspected work done by the Wheelock machine. Mr. John Wheelock himself told me of this boring mill, and spoke of it in terms of unqualified commendation. At the Wheelock shops I met, in the first instance, Mr. Edward K. Hill, president, who politely and firmly refused me permission to enter the shop, and informed me that the cylinder boring machine was not a tool which he would allow described as in use at the Wheelock shops. Mr. Hill said the tool was not good, that while its work was usable it was not up to present requirements, and that drawings were under way for a very carefully considered structure, which would certainly not take the form of the machine here shown.

Finally, influenced solely by most commendable considerations of the possible historic and educational value of a description of the machine, Mr. Hill gave me permission to show it, and himself furnished the signed details of one cylinder boring operation which is given here, with as Fig. 9. It must be remembered that this mill has bored all of the larger Wheelock cylinders, made at Worcester; and the excellent satisfaction given by the Wheelock engines to their users must also be borne in mind. It is quite possible, in view of the job details and measurements in Mr. Hill's Fig. 9, that the flexibility of the Wheelock piston packing has been a greater factor in the success of the Wheelock engine than the accuracy of cylinder bore produced by the Wheelock boring mill. Nevertheless, the mill fully merits that attention which it is always well to give to unique examples of really original work.

It is clear from Fig. 9 that the globe journal feature of the Wheelock boring bars is a *too* short cut for reaching a desired end. The universal adjustability of the journal should not have been obtained in so simple a manner. Had the cylindrical boring bar journal been retained, and the universal adjustability secured through hanging the cylindrical bearing for the cylindrical boring bar journals in gimbals it is quite likely that the bars would bore true cylinders. Evidently the globe worm wheels do not act efficiently as boring bar supports. The worm gears for driving the bars should undoubtedly have been larger, as heating of the driving worms, due to friction at the thrust shoulder of the worm, forces the use of lighter cuts than the boring tools might take.

In a final conversation Mr. Hill expressed a very decided opinion in favor of a more elaborate and far more costly type of cylinder boring mill, and in discussing the proposed new boring mill of the Providence Steam Engine Company, which will be shown in this series, he said that he could see the way very clearly to the profitableness of an investment of $5,000 or $6,000 in a multi-bar cylinder boring mill, such as the Providence Co. have under consideration.

Fig. 10 shows a double tool-post planer saddle, by the use of which both of the

crosshead ways of the Wheelock engine can be planed at the same time where they are made arcs of two different circles. Mr. Hill thinks the crosshead ways are as well made on arcs struck from the piston rod center, making the use of this fixture needless. The Watts-Campbell and Providence Companies make angular crosshead ways, while the fine Reynolds-Corliss engines, installed by one of the Philadelphia traction companies within the last year, have crosshead ways which could well be produced with the ingenious planer rig shown in Fig. 10.

Undoubtedly the readers of the AMERICAN MACHINIST who are interested in steam-engine cylinder production will join me in thanking Mr. Hill for his courtesy and consideration in enabling me to put the Wheelock boring mill before them, and join also in my sincere wish for the success of the Wheelock Company in their new, finely-arranged and well-lighted shops.

American Mechanics Compared with Others.

In the New York *Sun* Mr. Hiram Maxim has given his views regarding the relative merits of American and European machinery, and the relative proficiency of American mechanics compared with those of other countries. Few men, perhaps, have had a wider experience with mechanics in various countries, and it is therefore gratifying to note that his comparisons are very flattering to American machinists and machinery, which are shown to be making rapid headway, he says:

"When the German Government decided to make rifles on the American interchangeable plan they purchased from the Pratt & Whitney Co., Hartford, Conn., about $1,500,000 worth of American tools. These were brought to Germany, and a manufacturer in Berlin, seeing the great advantage of the American tools, established a factory and commenced to build them on a large scale. To-day this manufacturer has not only practically driven English tools from the market on the Continent, but he is also sending tools to England and selling them at prices considerably below English tools.

"In regard to the supposed superiority of English-made tools, I would say that when I first came to England, wishing to buy lathes, I examined a large number by different English manufacturers, and I was surprised to find how old-fashioned they were. Upon asking why they did not make better lathes, they considered it a good answer to say: 'Oh, everybody knows that everything of English make is very much better than anything made abroad.' Hardly a manufacturer knew of the existence of the new American tools. So when I had to equip some very large factories, I found it much to the advantage of my company to purchase the greater part of the tools from American makers.

"Americans also excel in the manufacture of revolvers and sporting rifles, while for woodworking tools and machinery they are far ahead of all other nations. They are also ahead in automatic machinery for working metals, and also in boot and shoe machinery, etc. There are, perhaps, about as many great inventions made in the United States as in all the rest of the world. The English may be considered the most skillful manufacturers of high-class woolen goods. They are quite equal to any in the manufacture of velvets and plushes. The hand-made double-barreled guns used for sporting purposes have reached a higher degree of excellence in England than in any other country. The English also have a leading position as builders of ships and marine engines. Microscopic and photographic apparatus is also very well done in England. Germans are very good mechanics; they are quick to appreciate the advantages of a new system and to adopt it. German tool makers have profited very largely by the introduction of American tools. Only a very few such tools, as, for instance, milling machines, etc., are imitated in England, but the Germans imitate every mortal thing of any value made in the States, and their work is only slightly inferior to that of Americans. I have purchased and compared genuine American tools with German imitations, and have found that the castings of the former are sounder and stronger, and that the deviation from truth, though very small, in the German tools, is three or four times as great as in well-made American machines.

"Frenchmen are all-around good mechanics. The imitation of American tools made in France is nearly as accurate as the genuine articles themselves, while their instruments of precision are quite as accurate as those made in the States, but they are not made in quantities as is done there, and so the price of the French instruments is four or five times as great as the American."

Speaking of imitations of American articles in foreign countries, he said:

"I was very much amused to find such a large number of very small gun shops, little shops about eight by ten feet, employing about two men, and everybody was working on Remington rifles. They sold a complete rifle for about $2, with 100 rounds of ammunition. I asked how this was done, and found that the barrels of the guns were rejects from Belgium, that all the mechanism of the gun was made of malleable iron and case-hardened. Upon examining one of these guns, I found marked on the barrel 'Manufactured by the Remington Arms Co., Ilion, New York, Patented so and so.' I asked them why they stamped this on the barrel, and they informed me that the guns they made were sent to Africa, and nobody in Africa would buy a rifle that was not made in the States. Each factory had a genuine Remington rifle as a model, and these were used as jigs and gauges for the imitation guns which they were making."

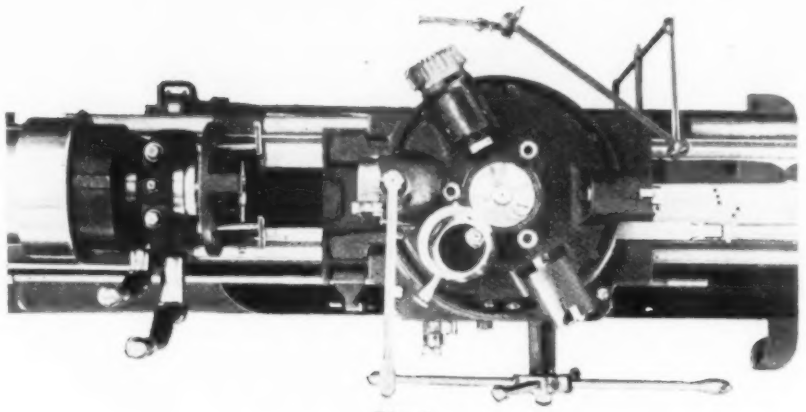


Fig. 1.

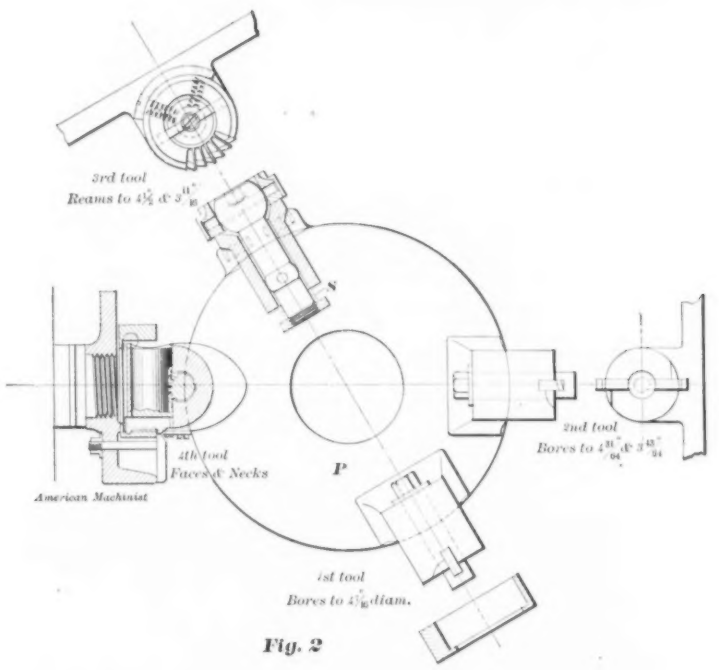


Fig. 2

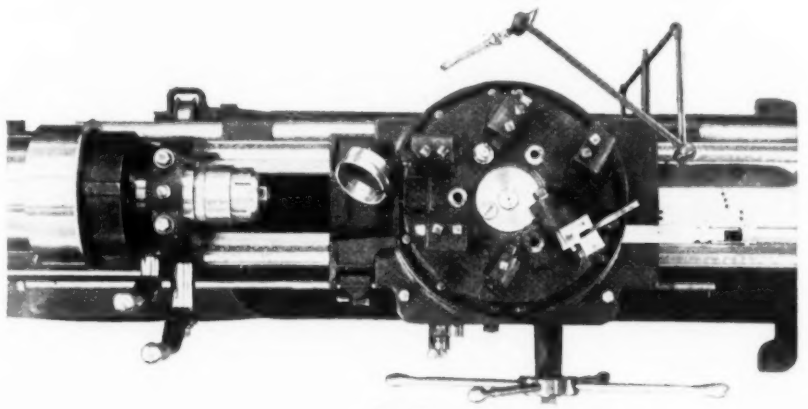


Fig. 3.

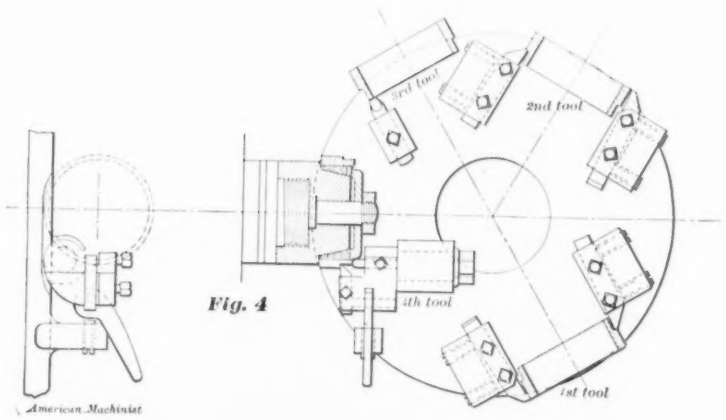


Fig. 4

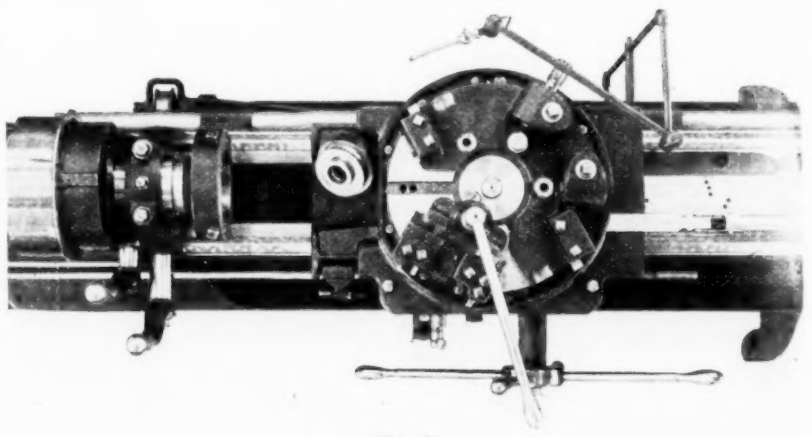


Fig. 5.

New Tools for Turret-Machine Work.

In a previous issue we gave some account of the Jones & Lamson Machine Company's shops at Springfield, Vt., and of some of the methods pursued in them. We now present illustrations of what may properly be called their new system of doing work in the turret-head machine.

Every one who has had experience with screw machines knows that for every job put upon such machines there is, somewhere, a minimum number of pieces which must be made after the tools are "set up" (*i. e.*, selected and adjusted to place in the machine) which minimum number must be made before changing, or it will pay better to do the work in the lathe by the usual method

This minimum number varies with the character of the work, but any plan by which the labor cost of "setting up the tools" is very materially reduced, of course, extends the field of usefulness of the turret-head machine.

Besides doing this the plan to be described enables the tools to be held with consider-

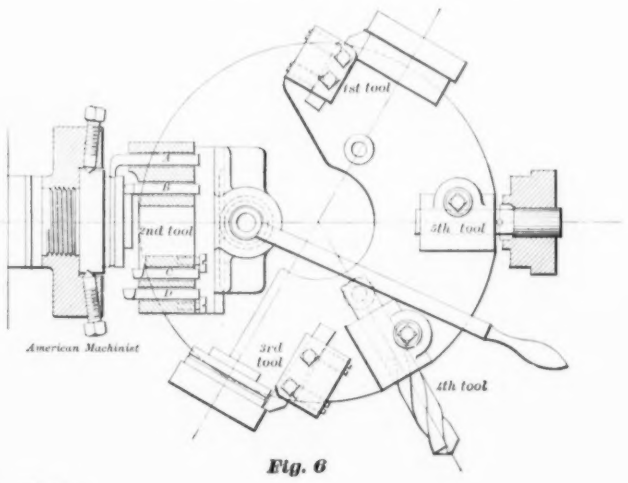


Fig. 6

NEW TOOLS FOR TURRET-MACHINE WORK.

ably more rigidity than when each one is held separately, and by it jobs to be easily done which could not otherwise be readily accomplished except by the lathe in the regular way.

The new plan consists, in the main, of having the tools for a given job all fitted up and properly adjusted to a solid ring or plate of cast-iron which is doweled and bolted to the top of the flat turret—a form of turret which, of course, is especially adapted to the purpose.

In order to make the matter understood we give engravings showing some of the tools and operations arranged in the Jones & Lamson shops for making parts of the flat turret lathe itself, besides a few other examples.

Fig. 1 is from a photograph of the machine as set up for performing the third operation upon the outer sleeve for the J. & L. M. Co.'s automatic die. This is an eccentric and is $5\frac{1}{4}$ inches finished outside diameter. It is cut by sawing from a bar of open hearth machinery steel, and a plain eccentric hole is first made through it and it is faced on one side. It is then held upon an eccentric expansion arbor and finished outside, the arbor referred to being fitted to the thread of the spindle and a split taper sleeve used to hold the work upon. Fig. 2 is from a drawing and the tools are marked to indicate the order in which they are brought to the work. When this job is to be done it is necessary only to put the proper chuck onto the spindle and fasten the plate *P* to the turret.

It will be noticed that the third tool is a reamer which is so held that it can adjust itself to any slight inaccuracy, and thus always ream its true size. The spring *S* holds the reamer back against the square shoulder to insure its entering the work fairly, but is not stiff enough to prevent its yielding one way or the other when entered and cutting.

Figs. 3 and 4 show the arrangement for performing the outside operations on a forged steel collar. This collar has previously been bored and reamed, also faced on one end. In the present handling it is held on an expansion arbor, the first and second operation being the rough and finished turning of the two diameters. The third operation faces the rough end, while the fourth operation faces the rough end to its exact length. At the same time it faces the shoulder, for the limit of variation at this point is but .001 inch. End elevation of the fourth tool shows a small cam that feeds these tools in almost radially.

Figs. 5 and 6 show the first turning operation on the automatic die body. These pieces are now made of tool steel, and come to the machine as left by the cutting-off saw, from a $4\frac{5}{8}$-inch bar. The chuck is of special interest, for it seems to be the only kind of chuck that will hold the piece against the action of cutting tool *B*, held in cross slide No. 2. The first tool roughs the diameter to $4\frac{31}{64}$ inches; the second shoulders down to $2\frac{5}{8}$ inches diameter, and at the same time cuts a groove with tool *A*. The reverse motion of the cross slide brings into operation end-finishing tools *C* and *D*. The third tool turns to the finished diameter of $4\frac{1}{2}$ inches. The fourth tool is an ordinary drill, and the fifth reams and counterbores a hole that is not important except for clearance.

Fig. 7 shows the method for turning piston rings of sizes from 12 inches down. The first operation being that of rough turning for a single ring, the second taking the finishing cut for the same, and the third facing and cutting off the ring to its exact width. It will be noticed that the last operation provides for a tool on the inside, which cuts a groove into the metal so that the outer parting tool leaves less burr on the finished piece.

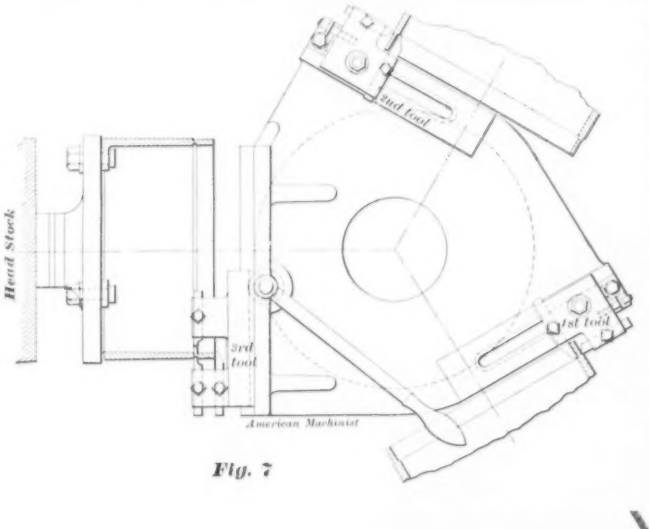


Fig. 7

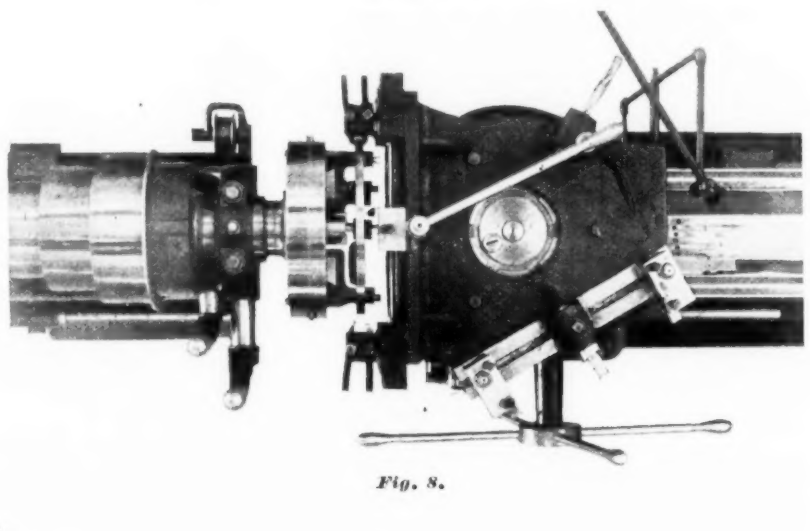


Fig. 8.

Figs. 8 and 9 show the method as applied to turning gears. These gears are held by a special-jawed chuck that opens inside of the rim, and is provided with clamps which pass over the arms. There is a feature of this outfit not shown, *i. e.*, the inner facing tool for facing the inside of the hub. This is a dead spindle fitted to the live spindle of the lathe, and is operated from the outer end, the inner end having a cutter that acts on the inside of the hub the same as the counterbore. The first operation, as indicated, faces the side of the rim and the outer end of the hub. The reverse motion of the same cross slide finishes each side of the rim. The second operation carries a twist drill and roughing and finishing tools for the outside diameter. The tools as shown were for a class of work that was not very particular, so that the finishing tool was allowed to finish a short distance back of the roughing tool. In some cases the roughing tool would be set far enough ahead to completely travel across the rim before the finishing tool started to cut. The reamer and counterbore occupy the third position.

Fig. 10 is the tool for working on the interior of the J. & L. M. Co.'s roller-feed casting, which is about 8 inches in diameter. The first operation in this case is to rough-bore the largest interior diameter, which goes to the depth of about $\frac{1}{4}$ inch. The second tool is the same except for size, and finishes to exact fit. The third tool is a boring bar which bores the small hole, and the fourth is a cross slide which carries five cutting points. The first operation employs three of these tools, one of which faces the outer end, and the other two are used in facing the shoulder and inside end of the boss. The remaining two tools in this fixture operate with the reverse motion of this slide, and finish the same surfaces that are roughed by the opposite tools. The reamer acts last, and it will be noticed that the reamer is loosely mounted. One feature peculiar to all these jig tools with cross slides is illustrated best by this last print, and that is that the tool block in the cross slide is so constructed that it may be run out of its slide and another used without disturbing the setting of the tools.

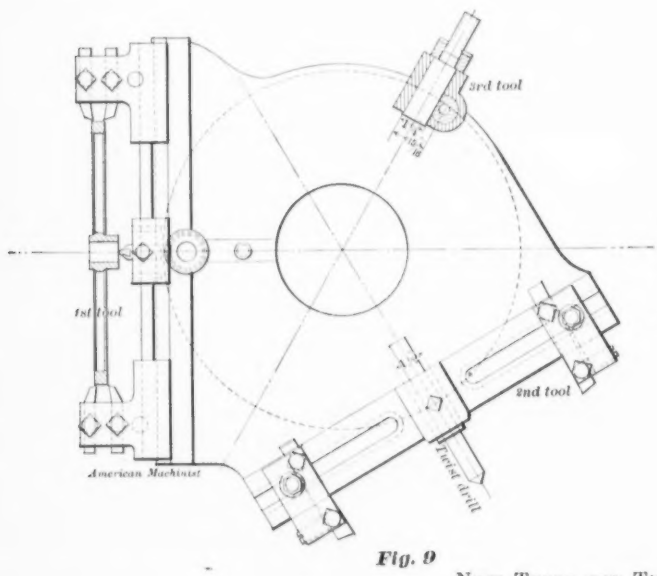


Fig. 9

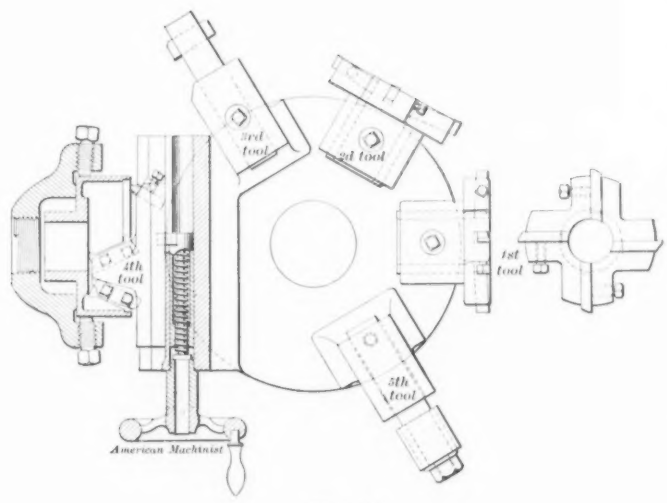


Fig. 10

New Tools for Turret-Machine Work.

We have an inquiry from the superintendent of a large cotton-mill in Constantinople, who wishes to know where in this country machines are made for making carding, in which cloth is used as backing instead of leather. We infer that he has such machines made in England, but wishes to know what is done in that line in this country. Will makers of such machinery, or those who know where it is made, please advise us?

Gas and Oil Engines.—II.

Mr. Geo. Richmond, being called upon, spoke of his experience in looking for a gas engine suitable for driving small refrigerating machines, and stated that he had found that the oil engines had, to a great extent, superseded the gas engine in England. He disavowed being an authority on the subject, and introduced Mr. W. Lawrence Wildy, a member of the Institute of Mechanical Engineers, of England, and of the German Society of Engineers, and representative of Hornsby & Sons, of Grantham. Mr. Wildy said, in part:

Most of you know, doubtless, that the producer is an ordinary cylindrical vessel lined with fire brick, and more or less intricate in shape, according to the inventor's idea of what his patent is, and with certain cooling surfaces, or heating surfaces, or conducting surfaces, or something; but you will find 150,000 patents in the patent journal, doubtless, and they have all got something about them. But the simplest producer I have ever used was a column of fuel about 10 feet high. The fuel we used in England was coke—the coke which after distillation of the gaseous product was a residue which went to make the cost of the production of gas a mere cipher to the corporation running that gas concern. In Leeds, where I had my experience principally, the gas which was distributed through the houses cost nothing in the holder—it was all profit. I have seen the figures, and I have gone into it with the chairman of the Gas Committee of the Leeds Corporation, and it is a fact that it was a decimal short of nothing in the holder. You laugh, but I am telling you the facts. The by-products from making the bituminous gas were so valuable at that time that they paid all the expense, interest and depreciation of plant, and the gas in the holder cost nothing but distribution and collection of accounts. We were using enormous quantities of gas for welding steel tubes. We made tubes of varying diameters from 20 inches to 60 inches, and these varied in thickness from $\frac{5}{16}$ to $\frac{3}{4}$, and we welded these with the ordinary coal gas, and our gas bill ran from £6,000 to £7,000 a year. I got hold of this water-gas process, as it was made in Germany at the time, and I saw that it seemed a very good heating medium, very cheaply produced, and we went in for a plant there. The plant was a magnificent success, so far as we were concerned. It reduced our gas bill from between £6,000 and £7,000 to just over £1,000 a year—fuel, interest, depreciation, labor, distribution—everything concerned came just over £1,000 a year, or something under one-sixth of what we paid before. That gas cost us on an average about three pence half-penny per 1,000 cubic feet. We made only water gas, but we got no by-products, and therefore it cost us something in the holder. In the water-gas business there are no by-products.

In the oil engine we have a machine which works with the ordinary petroleum of commerce, that is, any of the lighting oils which are in the market. It will also work with the heavier oils up to the specific gravity of .9, and it will work with an oil having a flash point of anything that the ordinary oils have, and up to 320° Fahr. Now an oil of 320° Fahr. is a pretty strong oil. The process through which this oil goes to produce its power is as follows: The engine is provided at the back of the cylinder with a small cylindrical chamber, which we call the vaporizer. On to this vaporizer is fixed a valve chamber, which really holds two valves, and which are the governor valves of the engine, the one opens inward to the vaporizer, the other opens by the action of the governor outward, and through a small pipe conveys any oil which is not required back into the tank from which the pump has drawn it. The rest of the construction of the engine, so far as its communicating the power imparted to it is concerned, is almost identical with the gas engine—a trunk piston and connecting rod, and crank shaft; on the crank shaft a pair of skew wheels, the skew wheels driving a

shaft—almost identical again with the gas engine—which shaft communicates motion, first, to the governors, and then to two valves, one for the air inlet, and the other for the exhaust; the air inlet cam at the same time operates a small pump from ⅝ to 1¼ inches in diameter, according to the power of the engine to be developed, and this pump has a stroke which can be adjusted by the regulation of the screw—that is, the oil pump—so that the amount of oil which is injected into the vaporizer is exactly in proportion to the power the engine requires. Suppose you are running the engine at half power, you run the pump at half stroke; if you are running the engine at full power, you run the pump at full stroke, that is, if you know you are going to do so. But if you are running the engine at full power, and throw off half the machine, the governor will do that, but the effect will not be so perfect as if you, knowing what you want, reduce it yourself. The exhaust valve has a double cam very similar to the gas engine, by which a portion of the compression can be released when starting the engine. Now, in operating the engine you begin by heating the vaporizer with a lamp, an ordinary paraffine lamp with a circular wick, to which a small fan is attached, producing for the time being a little petroleum forge. It takes five to ten minutes to heat that vaporizer. The only process is to fill the lamp, and turn the fan handle. As soon as it is hot enough you can turn your fly wheel, and your engine goes off at full cock; it is ready immediately, and it goes off at full power then and there, governing itself. The continual combustion of the oil in the vaporizer restores to the vaporizer the heat which has been extracted by the vaporization of the oil, and the heating of the air necessary to produce the subsequent explosion. These engines have been running continuously for two months, day and night, without stopping, without any hitch whatever, and the higher the work that is taken out of the engine, up to full power, the better the engine works. At very low powers the engine will want a little nursing, perhaps, but at full power she will work right along. We start our engine at 5:30 in the morning, and the men come in at 6 o'clock, and she is never looked at again, except when the man goes in at dinner time and oils her, and at half-past 5, when he goes to stop her, and there is no outside flame, no exposed red heat or dangerous flame of any sort about the engine.

Asked what he meant by nursing, Mr. Wildy said that if the engine has to run light for five or six hours, which I suppose no sane man would do under ordinary circumstances, it is possible that he may want to put a little brake onto the engine or something of that sort—to put a little work on her.

Asked if there was any residuum in the cylinder, he said: None whatever. We have run for two months and there was not as much as you could wipe off with your hand.

The consumption runs about seven-eighths of a pint of American daylight or water-white per horse-power on all sizes of engines. It runs a little lower, but only a little lower, on the larger engines than on the smaller ones. The very small ones will run to a pint. There is a greater loss owing to the friction of the engine itself. I am giving you the brake horse-power, not indicated horse-power. We sell the engine on the power which the purchaser is going to get off the fly wheel. He doesn't care what the power is in the cylinder. A 16 horse-power engine uses just .8 of a pint.

In Russia they are adopting these engines and we cannot keep pace with them. With us in England it is a matter of consideration, because the oil which I understand you give about 7 cents a gallon for, costs us about 6 pence half-penny a gallon. They are doing wonderfully well with the engines over there. Every class of power-user is adopting them, to the rejection of all steam engines up to 50 or 60 horse-power. They are in the hands of stablemen, gardeners, coachmen, all sorts of people, who after they are once instructed, know what to do.

The pressures in the oil engine are rather lower than in gas engines. In the Scotch gas I have had as much as 210 pounds initial pressure in the gas engine. The consequence is that the terminal pressure is so high that the exhaust becomes noisy.

The following written discussion was contributed by Mr. Paul Winand, superintendent of the Otto Gas Engine Works, Philadelphia:

PHILADELPHIA, April 11, 1895.

MR. F. R. HUTTON,
Sec. A. S. M. E.

DEAR SIR:—I had the pleasure of being present at the meeting of your society, last night, and would have asked for the privilege of making a few remarks on the subject, as a representative of the Otto Gas Engine Works, had it not been for the lateness of the hour at the close of this very interesting discussion. May I be permitted to offer these remarks in writing as a supplement to the discussion?

It was a pleasure for me to add my share of applause after Mr. Reeves' very able exposition of the subject. I fully concur with the same, except on a few minor points.

Concerning gas lighting by incandescent burners, I know by actual experiment that the temperature obtained from producer gas is not sufficient for the purpose. On account of the large percentage of inert gases which it necessarily contains, it is not even economical to enrich it for lighting purposes. However, by reason of the cheapness of the power obtained from this gas, electric lighting is generally the best possible way of providing light in such an installation.

Pure water gas, though it can well be used in incandescent burners, is more expensive per heat unit, and on the whole cannot compete with producer gas.

It is generally thought that by increasing the number of impulses, the gas engine can be greatly improved as far as regularity of motion is concerned. This is only an argument of relative value, however, as the question resolves itself to this:

Whatever the number of impulses may be, there must be fly wheels of sufficient momentum to produce the desired degree of regularity. Now, is it cheaper, more economical and generally preferable to have a simple engine with a large amount of momentum, or a more complicated one with smaller fly wheels? The same regularity can be obtained in all cases, and it has not been proved that a simple engine of sufficiently high speed is not the more preferable solution. Considerable experience in this line has shown to me that it would be decidedly wrong to complicate the construction in order to get more than one impulse for each revolution. I should wish to emphasize the point made relative to the use of fuel gas for industrial heating purposes concurrently with its use for power. The advantages of gaseous fuel when applied not only on a large scale, as for metallurgical operations, but in smaller apparatus of various kinds are being gradually recognized.

The engines at Danbury, so carefully tested by Mr. A. Burchard, were built by the Otto Gas Engine Works with the provision, as he has stated, that they could be operated indiscriminately by producer gas or by illuminating gas. The latter gas having about six times the heating value of the former, it will be easily understood that a compromise had to be resorted to in the construction, the result being that the engines do not give the best possible efficiency in either case. Engines built solely for producer gas would give better results. A test of a similar engine has been made by Professor Spangler, and was published in the *Journal of the Franklin Institute*, May, 1893. These engines were designed in 1891, and naturally engines built to-day show a marked advance in construction as well as in economy.

Since steam is being used in the Danbury plant for various purposes, it was quite natural to employ a small steam engine for starting the gas engines. The large engines built now by us are provided with a self-starting device, which renders the use of auxiliary power unnecessary and greatly enhances the convenience of operating the plant.

The efficiency of a plant depends on the choice of the units of power, and perhaps a better result could be obtained in this case, if the units were differently selected.

It should also be borne in mind that the producer used is large, and would be capable of furnishing gas for a greater amount of power, especially if the load factor was more favorable as it would be, for instance, in the operation of a mill or of a water-works, and I might well state here that gas power is being used extensively in Europe for the last named purposes. The assumption made by Mr. Burchard that 25 per cent. of fuel should be allowed, that is, added for the production of steam, is rather too high. In numerous tests made abroad, the coal used for steam was found to average about 12 per cent.

Up to this date it has been customary to use a steam boiler in connection with the producer. This is not a necessity, however, and we operate in our works a producer plant without boiler. The necessary amount of water vapor which passes with the air through the producer is generated at atmospheric pressure by means of the waste heat of the gas as it leaves the producer. There is thus no additional fuel used for producing steam, and besides the operation of the apparatus is rendered almost automatic.

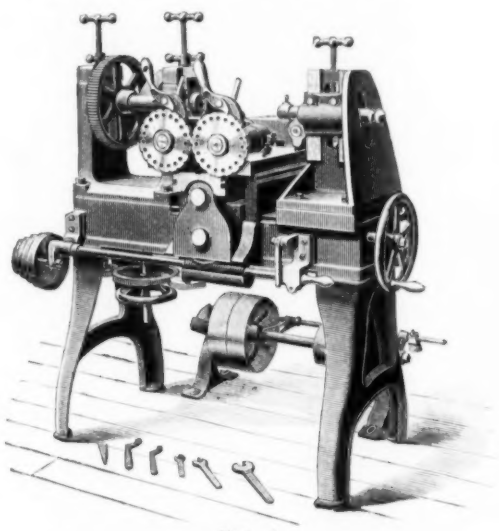


Fig. 1.

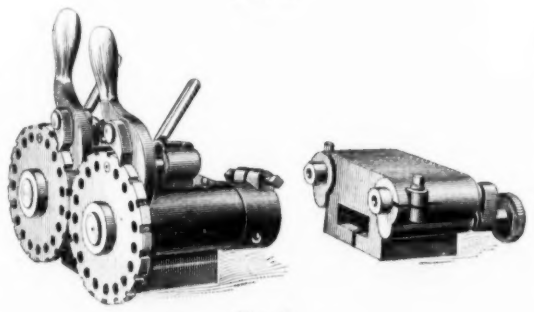


Fig. 2.

SPROCKET MILLING MACHINE.

Mr. Richmond has stated that oil engines were not made in this country, that they were, in fact, hardly known. Such engines have, however, been manufactured here for several years, and considerable efforts have been made for their introduction. We ourselves are fully prepared to begin their manufacture if a sufficient demand should arise. But in view of the fact that gasolene engines are so much preferable in most every respect, it is not surprising that the demand for oil engines should be so small. Gasolene engines have all the advantages of gas engines, and in some of those built in this country to-day the provisions for safety are so absolute that the insurance companies have no objection to their use. Besides the objectionable smell which seems inseparable from the oil engine, there is the objection of its not being ready for starting at a moment's notice. Oil engines are naturally wasteful when running at partial and variable load. This is due to the fact that the proper degree of temperature is not maintained at the different loads which occur in practice. When a continuous external flame is used for maintaining this temperature the fuel consumed in this flame decreases the efficiency at reduced loads.

The oil engine described by Mr. Wildy was exhibited at the World's Fair. In this engine the ignition of the charge depends on the temperature of the chamber, which is left uncooled at the rear. The temperature of this chamber, and consequently the time of ignition vary with the load, and this circumstance produces an additional variation of the efficiency with the load.

Oil engines are naturally somewhat more complicated, more expensive, and less convenient than gasolene engines, and unless there be a marked difference in the prices of the two fuels, the latter would seem preferable in most cases.

As a conclusion, I would remark that all those actively engaged in the development of internal combustion engines, cannot fail to feel gratified at the increasing interest which is manifested in this subject, and of which yesterday's discussion was a remarkable instance.

Sprocket-Wheel Milling Machine.

We present illustrations of a machine for milling bicycle sprocket wheels, built by the Garvin Machine Company, of Laight and Canal streets, New York.

It consists of a Garvin No. 1 Lincoln milling machine, with special heavy tail stock, power feed and automatic stop. On the table of this machine is a double-spindle indexing or dividing fixture, mounted in an oil pan with the spindles placed side by side, each fitted with an independent indexing dial, operated by a hand lever, and having the same number of divisions as the sprocket to be cut. This arrangement permits of easy and rapid manipulation and insures accuracy in the work.

The pieces to be milled are mounted in gangs on arbors which are securely fitted in the two indexing spindles, thus permitting a large number of sprockets to be milled at one setting. The cutter arbor carries two cutters having the exact form of the space required between the teeth on the sprocket, thus at each cut finishing a tooth in every sprocket in both gangs.

The cutters are so made that they can be sharpened by grinding without changing their form.

We give an enlarged cut of the index centers, and it will be seen that they can be used on any power milling machine or planer. The fixture is made with only one spindle, if desired.

Compound Plagiarism.

A paper read before the Western Foundrymen's Association, by Chas. Sisson, having been found to be copied almost entirely from a book called the "A B C of Iron," written by a man named Sisson, the association passed a resolution expunging it, and all reference to it, from the records. Now a writer in *The Journal of the Franklin Institute*, signing himself "W.," compares the "A B C of Iron" with other writings especially in the journal mentioned, and concludes that:

"With the possible exception of a chapter of three pages on 'How to Reduce Cost of Mixture,' concerning which Mr. Sisson is entitled to the benefit of the doubt, the remainder of the book is simply a piece of patchwork made by a bungling amateur, with the aid of scissors and paste pot and conjunctions." It is well known that there is altogether too much of this sort of work, and it is a good thing to expose it when occasion offers. There are too many writing books who have no call to write them, and no ability to write them, and of course they must steal their matter.

New Double-Tenoning Machine.

We present herewith an engraving of a new double-head tenoning machine, which will cut to uniform length, and accurately tenon both ends of work, varying in length from 6 inches to 54 inches, and up to 20 inches wide and 7 inches thick, being intended for the use of manufacturers of doors, sash, furniture, wagons, cars, etc.

As will be perceived, the machine is substantially proportioned, and one head is movable upon the bed to suit any length of work. These housings support all the principal working parts of the machine.

The spindles that carry the tenoning heads are of steel $1\frac{7}{16}$ inches diameter, lead ground, and provided with self-lubricating bearings, between which are placed the driving pulleys, which are driven by belts provided with tighteners, keeping a uniform tension for all positions of the spindles.

The heads have a vertical adjustment upon the housings, and the upper heads have lateral adjustment, by means of which one side of the tenon may be made longer than the other, if desired.

The mandrels that carry the saws are located on the opposite sides of the housings in advance of the cutter heads, have independent, vertical, and lateral adjustments. The coping attachment is located back of the tenoning heads, mounted on adjustable slides, and driven from independent countershafting, supported on the machine.

The feeding mechanism is automatic in its action, and is so arranged as to produce accurate work of all dimensions within the nominal capacity of the machine.

Provision is made for changing the angle of the cut and length of tenon. The material is held in position by adjustable sectional pressure bars, holding each piece perfectly rigid while being tenoned. There are four changes of feed, varying from 15 to 45 feet per minute.

Double-Tenoning Machine.

LETTERS FROM PRACTICAL MEN.

The Electric Motor in the Machine Shop.

Editor American Machinist:

Anent the articles that you have published in regard to electric motors in machine shops, I here tender a few remarks on the subject as an expression due to practical experience, as I make great use of electrical power for driving various machine tools, overhead traveling cranes, etc.

I am of Mr. Melotte's opinion that electric transmission is of great value, especially in the case of works where an extension calls for ordinary increase of power above the original plant installed.

In such cases the plant should be divided, and the extra section driven by electric motors.

The same applies when tools are to be driven at a considerable distance from the main machinery.

But what I cannot admit with Mr. Melotte is that there should be electric motors simply for the purpose of driving machinery in that way when connection could better be made direct to the steam engine in the ordinary manner.

If memory serves me aright, at Herstal, the Grand Hall, where the machine tools were located, was equipped with several driving plants which could easily have been actuated by the main engines, and the electricity could have been made use of for machinery out of direct connection, or to add to the driving power of such tools, etc., as were found insufficiently supplied by the main method of transmission.

I cannot admit that there exists any direct *advantage* in driving electrically.

In driving directly from the engine there is the loss by the belt or ropes, and this loss exists for driving from electric generators. Consequently these two losses being about equal there is the additional loss in the use of electricity between dynamo and motor of, say, 30 per cent. Where a portion of the plant is to be shut down, I am of the opinion that friction clutches will answer the purpose, and be as handy, practically, as the switch.

In my opinion it will be found advantageous to drive parallel shafting by the main engine.

Electricity can properly be used where the machines to be driven are isolated and subject to frequent stoppage.

The losses through ordinary methods of transmission are very often referred to, but I think the figures usually given are misleading.

In our works we have the following machines:

76 machine tools.
1 smith shop machinery.
1 fan blower.
1 steam hammer.
1 belt operated trip hammer.
1 emery grinding wheel.

And in addition the usual small auxiliary tools, and the same driving power has to supply the foundry with power for the blowers (12 H. P.).

Our main engine is 400 mm. (15⅝ inches) diameter by 800 mm. (31½ inches) stroke, and runs at 66 revolutions per minute, absorbing 10 H. P. for friction, and leaving 18 H. P. for useful effect.

At present we are working 10 hours per day, and 300 days per year, and our boilers vaporize 8 kilos of water per kilo of coal (8 pounds water per pound of coal nearly), coal at 13 francs, 90 centimes ($2.70 nearly) per ton, so that I believe in our case there will be no economy in driving machine tools by means of electric motors, especially if we consider that the dynamos would here be driven by belts.

At all events, as the outlay should properly return 15 per cent. (taking into account interest, depreciation, wear and tear, etc.), I could not even with a saving of 695 francs ($135)—even were such purely saving—expend a capital of 4,600 francs ($888 nearly) on motors, and even if this sum could be expended with profit, it would equip very *few* motors in a proper and satisfactory manner.

A. Bollinckx.

Brussels, Belgium.

Cutting Square Threads.

Editor American Machinist:

I notice what "A Mechanic" has to say about cutting square threads in the American Machinist of March 21st. He gives a good plan for making tools for cutting square threads. Now, if he or some other readers of the American Machinist will tell us *how to cut square threads*, it would no doubt be interesting to those who have that kind of work to do at least. For instance, how many times should the tool pass over the work in cutting, say, a thread of five to the inch, the bottom of the thread to be three-sixteenths of an inch less in diameter than the top of thread on soft machinery steel, such as undoubtedly a majority of the steel screws are made of, which is steel only by being removed from iron just enough to have a steel fracture? Also, at what surface speed should the screw be run, and should the top of tool be ground square with the lathe or square with the angle of thread, for instance, with a screw of small diameter and coarse pitch? I think that any practical information on the above, as well as any other points that come up in practice that might be given from actual experience, would be of interest.

Has any one tried to cut square threads with a die or otherwise than with a single point tool; if so, we should be pleased to hear from them, stating what kind of tools they used, giving pitch, diameter, and material operated on, and with what success they have met. There is scarcely a machine tool made that does not have one or more square thread screws on it, and they are being cut every day. If some of these parties who are cutting them would give us their experience, it would no doubt interest a large majority of your readers.

Albert L. Colburn.

New Haven, Conn.

Shrinking in Crank Pins.

Editor American Machinist:

In your number of 7th March, under the heading of "Some Cincinnati Shop Notes," we observe, page 185, first column, that Messrs. Lane & Bodley have departed from the usual practice, and that crank pins are simply forced or shrunk in, and secured in no other way.

We are glad Messrs. Lane & Bodley have, after a visit Mr. Lane paid us, about a year ago, inaugurated a system that we have followed for the last 12 years, and which has given us complete satisfaction, and if more evidence in favor of our process was required, the adoption by Messrs. Lane & Bodley would be a sufficient proof.

But not only are our crank pins forced or shrunk in, but also our fly wheels are fixed on the shaft without keying, being made in halves and clamped on the shaft. I hope you will publish these few lines, for, "*Rendons à Cesar ce qui appartient à Cesar.*"

Brussels, Belgium. Bollinckx.

The Best Engine Setting.

Editor American Machinist:

Noting Mr. Sam'l T. Williams' query in the American Machinist of March 21st, "What is the latest and best practice in engine setting?" which you refer to your readers, it occurred to me that having been a reader of the American Machinist, or to be more specific, having read every issue of that paper from No. 1, Vol. I., to the present, and having at the same time an engine-setting experience covering a like number of years, that possibly what little knowledge I have obtained in that line and time might be of some value to—well, those who have not read the American Machinist as long as I. Let it be understood, however, that I do not claim my way as the latest and best; it is the way that has given me the best results with the least labor. It will be necessary to assume that we have a good foundation, and a level coping stone to start on—this word foundation makes me shiver. Ye descendants of Hiram, who always know just how to build an engine foundation, or set a boiler just right, what troubles we engine men have had, and have had to sweat for, when none but ourselves (and the Recording Angel, we hope) would believe that anything could be wrong, but the way the engine was built, or the way it was set. What a chance for someone to blow themselves on foundations—there is certainly lots of room.

Well, after getting the bed of engine set down over bolts on foundation, I have ready a package of pieces of stove-pipe iron that can be had from any country tinsmith; size 2″x5″, or thereabout. After getting the engine frame fairly well in line with the shaft it may have to drive, I begin on the crank end, and with a couple of iron wedges to raise the bed more or less, I shim up with the sheet-iron pieces on each side of the two front foundation bolts, and about 3 inches away from bolt, until level in line of shaft. I then draw down the nuts on these two bolts for keeps. If when they are down solid, bed is not quite level across front end, I slack up the nut on low side, drive my wedges and shim up with more sheet-iron strips, or if this is too thick, a piece of tin, of course, taking the wedges out as soon as I get my shims in place, and again draw down on nuts on foundation bolts. If it is now level, that end of the bed is there to stay. I now go to the other end of the bed, and repeat the operation, except that at the same time I level on the guides. With both ends fastened securely and all level, I test for alignment with shaft, and right here comes in one of the chief advantages of the flat sheet-iron liners or shims; you can slack up on either end of engine bed, and move into line without affecting your levels—which you cannot possibly do with wedges in place of the sheet-iron—presuming that it is not necessary to move the bed, as it seldom is—I then take a light hammer and drive in all the pieces of sheet-iron that will go one on top of the other, 3 or 4 inches from each side of all the intermediate foundation bolts between the end ones that have

been made solid. This done, I screw down the balance of nuts, and the job is done, and I want to say that I know it will stay as long as the nuts on foundation bolts are kept tight.

To make a clean looking job, or satisfy someone's prejudice, I usually fill in under bed with brimstone or cement, either of which will answer. This is my best way. There are many others, I have no doubt, who use the same *modus operandi*. I hope to hear from some of your readers who will perhaps offer something better.

Chicago. J. S. STEPHENS.

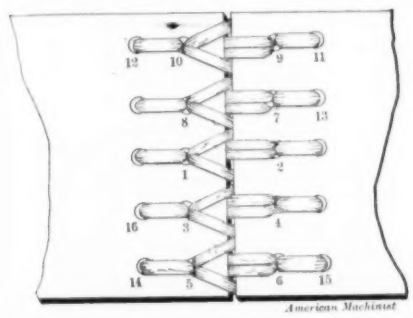
Belt Splicing.

Editor American Machinist:

There are times when a specially strong splicing is required for belts. A description is given below of a method of lacing heavy belts on the "hinge" principle, and which has proven effective in cases where other splices have failed.

The chief point in the hinge splice is that it can be worked like a hinge. Where a belt travels over a large pulley, and does not need to bend very much, almost any kind of a splicing will do. But if the belt must go around small pulleys, an ordinary splice will not stand the strain.

If a splice which has been made according to the usual way is worked up and down like a hinge, the lacing soon works loose,



and at times will break. The hinge-laced belt can stand any amount of work of this kind.

The lacing laps on each side of the belt in common splices, and these laps extend across the ends of the butts from hole to hole.

The result is the union cannot be bent into a very small circle without straining the lacing, and perhaps tearing out the holes in the leather. Now, if such a splice is made to run over small pulleys, the result is disastrous. In a hinge splice the peculiarity of the arrangement of the lacing, by which each end passes the other between the butts, forms a perfect hinge movement.

In making the hinge splice, a row of holes should be punched in the belt about three-fourths of an inch from the end, using a No. 7 or No. 8 punch. Directly back of these another row of holes should be punched with a No. 5 punch.

The ends of the belt should be pared to a feather edge. The lace used should be about five-sixteenths of an inch in width. Let the lacing begin in the middle of the belt at hole No. 1, dividing the lace about equal. Bring the lace up between the ends of the belt, pass down through No. 2, then up between the ends of the belt, down through No. 3, up between the ends of the belt, and down through No. 4, between the ends of the belt, and down through No. 5, up between the ends of the belt, and down through No. 6, again up between the ends, and down through No. 5, up through No. 14, down through No. 5, up between the ends, down through No. 6, up through No. 15, down through No. 6, up between the ends, and back to No. 3, down through No. 3, and up through No. 16, and continue in the same manner back to the middle of the belt.

With the other end of the lace begin at hole No. 1, pass it down between the ends and up through No. 7, down between the ends, up through No. 8, down between the ends, up through No. 9, down between the ends, up through No. 10, down between the ends, up through No. 9, down through No. 11, up through No. 9, down between the ends, up through No. 10, down through No. 12, up through No. 10, down between the ends, up through No. 7, down through No. 13, up through No. 7, and continue in the same manner back to the middle of the belt.

Any number of holes may be used.

A feature in the splice is the remarkably small amount of lacing required. A very short piece goes a great ways, and when made, this splice will last a long time.

A. DANIELSEN.

Melrose Highlands, Mass.

Standard Paper Sizes.

Editor American Machinist:

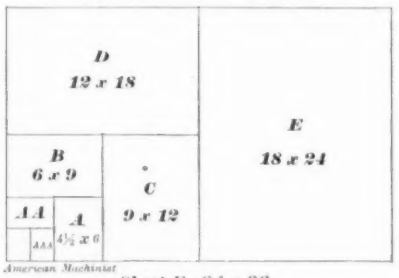
Having felt much interested in the subject of standardizing paper, cards, etc., for several years past, I thoroughly sympathize with your efforts in this direction, including a reform in the size of trade catalogs. Your proposed size of 6'x9" is, on the whole, I think, the best that could be fixed upon, although in some cases other divisor or multiple sizes, such as 9'x12" or 4½'x6", might be necessary also.

Several years ago I established a binary system, so to speak, for cutting paper, taking as the largest size sheets 24 x36", and cutting each one in half for the next smaller size, and that again for the next, and so on, all the way down, as shown in the annexed cut. These sizes were known and marked as sheets *A*, *B*, *C*, *D*, *E* and *F*; *A* being 4½'x6'. This system was found so very convenient that still another division was made, chiefly for sketch pads, which measured 3"x4½', as marked at *A A*. This again was so good that still another afterwards was made as at *A A A*, the size being 2¼"x3", and the sketch pads of this measurement being extremely convenient for one's upper waistcoat pocket, which is usually about the right size to receive it. Had I foreseen these latter subdivisions, I should, of course, have started the smallest of all with the letter A, but for this it is now too late. It is not likely, however, that regular drawing paper will need to be less than the size now known as "A."

The suggestion in your issue of April 18th, that business cards be standardized to a size 3' x5", is an excellent one, except that the figures should be 3"x4½", so that a thoroughly logical division may be carried downward throughout, from the natural size of 2 feet by 3 feet as a starting point, all as shown in sheet *F*. Otherwise paper would not cut to advantage, and the general logic of such a system would be broken up. The feature of keeping these cards in regular card-index style would be extremely convenient, and this convenience cannot be well attained with the heterogeneous assemblage of sizes now in use.

We sometimes find writers advocating some pet size of paper, which they have

Sheets of Standard Paper



Sheet F, 24 x 36

adopted, as 23"x37", or 19½ inches by something else, etc. There is in this civilized period of our existence no possible reason or sense in using these odd sizes, whatever the case might have been 20 or 30 years ago, when paper makers were more strict in their foolishness than now. At present there is no difficulty in having comparatively small quantities of paper cut to any reasonable size desired. The unit of 24"x36" is about right, both as to actual size and proportion of width to length. Furthermore, it is easily remembered as being in whole feet, and one of the dimensions a whole yard—thus adapting such sheets to be cut from rolls by the usual yard measurement. These features alone should commend it over any set of wild-cat dimensions that Tom, Dick and Harry might prefer. The binary division downward is extremely convenient, easily remembered, and conducive in the long run to a considerable saving of paper. Let us then, all of us, strive to bring forward the day when something of this kind shall be the standard, not only in regard to sizes of drawing and writing paper, but of business cards, postal cards, catalogs and even books—should it ever be possible to induce the book publishers to adopt any principle whatever of uniformity in their work.

In regard to envelopes, the case is, of course, somewhat different, as in some instances they must be made enough larger than the sizes mentioned to receive the same. My own usual practice is to have them ¼ inch larger each way.

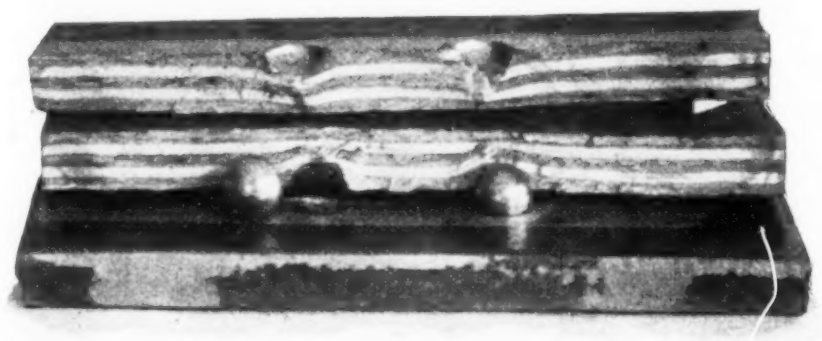
OBERLIN SMITH.

Remarkable Strength of Small Steel Balls.

Editor American Machinist:

I inclose a photograph which may be of interest to you and your readers, since it shows a most remarkable fracture produced by two steel balls, each ¼ inch in diameter, manufactured by the Cleveland Machine Screw Company for use in ball bearings.

The ruptured plate is made of alternate layers of hard steel and wrought iron, and



REMARKABLE STRENGTH OF STEEL BALLS.

was intended for use in the construction of safes. The rupture was produced by placing the two balls between two plates and applying a load while between the heads of a testing machine. When 124,000 pounds had been applied, one of the plates was ruptured through and through. The other plate, which was made by a different process, was uninjured. The picture shows the ruptured surfaces of one of the plates, with one ball in position.

The remarkable feature was that after the rupture was produced the most careful calipering failed to detect a change in the diameter of the balls equal to $\frac{1}{1000}$ of an inch.

R. C. CARPENTER,

Ithaca, N. Y. Sibley College.

[In a letter accompanying the above communication, Professor Carpenter says that some of these balls had been previously tested and found to possess a strength not far from 330,000 pounds per square inch, estimated on their diameters, and much more than that, estimated upon the area of the plane of fracture. The break shown was an accidental one, made during the course of some tests of various materials for burglar-proof safe construction.—ED.]

Improved Method of Brazing Flanges on Copper Steam Pipes.

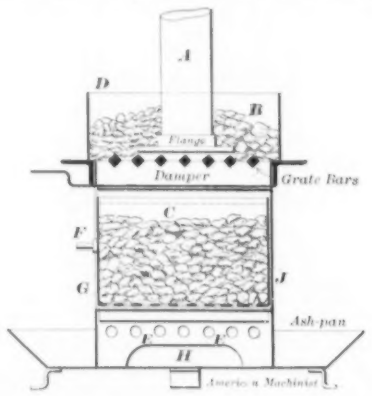
Editor American Machinist:

The accompanying sketch shows a furnace for brazing flanges on copper steam pipes that I think is a new idea, and as it gives very much better results, both as to uniformity of brazing and economy in charcoal consumed, than the time-honored methods in vogue in marine copper shops, a description may be of interest to many of your readers who are connected with such work.

The main drum *J* is fitted with an ash pan, and openings *E E* and the door *H* furnish the draught which can be accelerated if necessary by means of an air hose.

The main body of fuel, which is first brought to a full glow on the regular forge, is contained in the pan *C*, which is removable through the opening *G* in the main drum.

The pipe and flange to be brazed are placed upon the upper bars as shown, within the upper loose ring *D*, and charcoal is filled into the lower pan, and also around the outer circumference of pipe flange, and the damper



being opened flange and pipe acquire a uniform red heat.

The damper is then closed and the upper charcoal heaped around the flange and pipe as shown in sketch, and an air-hose blast is turned into the ring *D* from above until the brazing runs.

With the usual method of heating large pipes the waste of charcoal is out of all proportion to the work done, and by reason of the intense heat any very careful manipulation is impossible, and the brazing is seldom if ever evenly carried through between the surfaces.

With this furnace any reasonable skill will turn out a thoroughly brazed joint, and the risk of burning the metal is reduced to a minimum.

EDWARD C. MALONE.

Navy Yard, Brooklyn, N. Y.

Feed-Water Heaters.

Editor American Machinist:

Since the manufacturers of feed water heaters have decided to inform purchasers of the amount of heating surface in their particular makes, it seems to me that they might go a step further in the right direction by adding such information as the amount of water contained in the heaters, and the time required for a given volume of water to pass through, at a given rate of feed, and also the amount of feed raised a certain number of degrees by a certain amount of steam passing through the devices, at atmospheric (or other) pressure.

HEATER SALESMAN.

Hydrokineter.

Editor American Machinist:

Your correspondent 109, J. G. G., S. Lake, Mich., refers, I think, to the hydrokineter, an appliance used in British steamers to a great extent; it is simply an arrangement for heating the water in main boilers by means of steam from the donkey boiler, previous to starting the main boiler fires; the object is to avoid injury due to sudden expansion in furnace by a hot fire, when the rest of the boiler is cold. E. A. SUVERKROP.

It is claimed that remarkably fast time was made April 21st on the Pennsylvania road by the newspaper train between Philadelphia and Atlantic City. It ran from Camden to Atlantic City in 45 minutes, the distance being 58.3 miles, and the average speed 77.7 miles per hour. From Winslow to Absecom, 24.9 miles, the speed was at the rate of 83 miles per hour, and the fastest single mile was made in 41 seconds, or 87.8 miles per hour.

AMERICAN MACHINIST

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☞ *Every correspondent, in order to insure attention, should give his full name and address, not for publication, but as a guarantee of good faith.*

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☞ *We invite correspondence from practical machinists, engineers, inventors, draftsmen, and all those specially interested in the occupations we represent, on subjects pertaining to machinery.*

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Subscriptions received in Paris, France, by E. TERQUEM, 31 Boulevard Hausmann, at 21 francs per annum, postpaid.

Subscriptions received in Australia by W. WILLIAMS, 17 and 21 Fink's Buildings, Melbourne.

NEW YORK, MAY 2, 1895.

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Give the Full Address.

A well-known machinery building establishment writes us about a matter in which, it seems to us, our foreign friends are especially delinquent, *i. e.*, in the matter of putting upon their letter heads and all printed matter the full and complete address to which replies or correspondence should be sent. Our friends say, "we have the complaint to make of them that the writers [foreign correspondents] almost invariably fail to give their State, or more properly, country address, and we are often put to much trouble to hunt this up; this is sometimes very difficult to do, unless we preserve the envelope, and even that is not always as clear as we would like. Many of these inquiries we can trace to our advertisement in your journal, and we believe that by a little agitation you can show your foreign readers the necessity of naming their country in their inquiries, and of making it a part of their addresses."

The above quoted letter refers to a difficulty which we ourselves constantly experience, and we have heard of a number of manufacturers who make the same complaint.

It often involves considerably more expenditure of time to search for and make sure of the complete address of a foreign correspondent, than to write the letter to him, to say nothing of the risk of being wrong after all, and having the letter or catalog go to Yucatan or Patagonia perhaps, instead of to some province in the German Empire, as it should.

At the same time we venture to make a further suggestion, which, though not founded upon any complaint from our foreign friends, will nevertheless not be amiss. The words U. S. A. should appear upon every letter head of a firm having foreign correspondents. Bridgeport, Conn., or Camden, N. J., for instance, are not complete or sufficient addresses for letters mailed in an Italian or a Japanese post office, because the Italian or Japanese postmaster is probably not familiar with the names of all the States of this Union, and would not know that both letters were for the same part of the world. We think that every letter sent out of the country in which it is written should have printed or written upon it, separately and distinctly, the complete and full address to which a reply should be sent.

Fast Steam Launches.

In the old days—when twelve knots was considered a high speed, even for large vessels—those who were sufficiently familiar with the wave-line theory to turn out a set of lines that would not only conform to that principle, but would in addition make a practicable ship-shape construction, were not slow in explaining just why that popular theory of form of least resistance was not to be departed from, if speed was to be economically obtained.

Hard-and-fast rules were issued, setting down the exact lengths of fore and after bodies, for a given speed, and it was looked upon as the merest folly to attempt to drive a small launch at much other than a rowing pace.

Those theories of resistance have, however, been swept aside under the stimulus of the necessity of forcing torpedo boats and such craft to a velocity that even the mention of a few years ago would have subjected the utterer to ridicule, and thirty knots will soon be reached by boats of even fifty feet length.

At these speeds, the old stream-line theory of resistance, such as is found fairly reliable for from eight to ten knots, is no longer safe, the water in its endeavor to make way for the rushing hull rising in a sheet above the general surface, and in addition the lower layers of fluid are subjected to a violent shearing action, and the "viscosity" becomes one of the chief elements in determining the path of least action that the particles of water will necessarily take.

It no longer suffices to consider simply the horizontal or "water lines" of the hull; the upward roll of the fluid must have a proper outlet in order that the continuity may not be broken to a too great extent, otherwise an abnormal increase of resistance will result which will greatly vary, according to the particular speed at which the boat may be running.

Mere calm-water formula becomes less and less used as speeds increase, the detailed working out of the lines, or, rather, surfaces, to be propelled being the designer's only safe method.

Automatic Steering by Electricity.

A contemporary states that an automatic steering device has been originated in France, that will do away with the ordinary errors of the helmsman, by keeping a vessel rigidly to her course.

An invention of this sort was tried years ago on a steamer of the U. S. Navy, but it was conclusively proved that human intelligence is necessary at the wheel, and that any sort of simple attachment—electrical or otherwise—would not be satisfactory.

When a ship tends to fall off, and is brought up by the rudder, she hangs for a moment, and then starts to fall off (generally in the opposite direction), and it is here that a skillful steersman shows his fine hand. Instead of waiting until an actual swing is made, he depends upon the pull of the rudder to warn him as to the direction in which to oppose the wheel, and in this way he keeps the vessel on a straight course.

The electrical helm that depends on an actual swing to operate it, is useless, as once the ship falls off it requires considerable power to check her momentum, and at any sort of speed she will drift to right or left of her proper course, to a greater limit than would be tolerated by any commander.

In the above referred to navy experiment, the board of officers reporting on the invention condemned the attachment for the reason that "the ship pursued a serpentine course, etc."

While there is no doubt but that an electric steersman can be devised that will keep the vessel to a straight line, yet it is a question whether the cost of installation, wear and tear, supervision, etc., would not far exceed the wages of skilled and reliable seamen.

The Woburn Disaster.

The cause of the boiler explosion at Woburn, Mass., an account of which we gave in our issue of April 18th, has been officially set down as being due to incompetent men in the fire room.

The habit of employing cheap help around the boiler department will probably receive no check, in spite of the losses of life and property that are continually occurring, until State or national authorities take matters in hand, and force all connected with steam machinery to conform to the requirements of ordinary common sense at least.

A man responsible for the safety of a steam plant must be—properly—so familiar with the duties necessary to insure safety, that no emergency will cause him to act wrongly in the matter of relieving pressure, hauling fires, pumping water, etc.

The mere ability to answer set questions on examination is no criterion of his competency. He must be cool and thoroughly familiar with the effects of anything done on a boiler under steam, and he should in addition have a proper sense of responsibility as regards the safety of others, in addition to the necessary courage to remain by his plant in an emergency, until all preventive remedies have been applied.

A first-class fireman is a first-class man, and is not to be found among tramps at the roadside, and the employment of incompetents should be discouraged by rigid legislation.

Member of the Gang.

Under date of April 20th the Cleveland Twist Drill Co., referring to the Baltimore swindler, Uhthoff, says that "James W. Kane, of No. 1059 Hillen street, Baltimore, is one of the gang. . . . It was in his store (which is a harness store) that we found a large portion of our goods. He swore up hill and down that he had never seen any of our goods, but our representative . . . jumped over the counter and pulled the package out and sent it home by express."

From a manufacturer in New Haven we have a letter inclosing an order received by a neighbor of his from Uhthoff. There was some hesitation about filling the order because there was no rating, and while hesitating our friend was consulted about it, and upon seeing the order immediately recognized the letter head from our reproduction of it, and, instead of being filled, the order was sent to us as an addition to our collection of similar documents. There are other swindlers whom we are after and upon whom we shall train our guns as soon as sufficient sure evidence is gathered to make sure of the justice of our action.

Literary Notes.

THEORETICAL AND PRACTICAL AMMONIA REFRIGERATION. By Hlyd I. Redwood, A. M. A. S. M. E., M. S. C. I.

This work is intended for the use of those who are immediately connected with ice making or refrigerating plants. While the volume contains considerable practical information, it is to be regretted that a more systematic treatment was not undertaken. A work of this sort should open with a clear description of the cycle of operation of each type of machine, tracing the action of the substances employed throughout their working course. After which specific values should be determined, and the method of securing the best all-around results plainly pointed out.

We note that absolute zero is placed at —458.4° Fahr., —460 degrees would be probably nearer the truth, and would also prove a handier factor for calculations involving its use.

A number of statements, such as "the *necessity* of a gas absorbing heat when expanding," etc., should be stricken out.

The work is published by Spon & Chamberlain, of No. 12 Cortlandt street, New York City. Price, $1.

PLATING AND BOILER MAKING. A practical hand-book for workshop operations, including an appendix of tables. By A Foreman Pattern-maker, author of "Lockwood's Dictionary of Mechanical Engineering Terms," "Toothed Gearing," "Practical Ironfounding," etc.

In this book the subject of plating and boiler making is treated wholly from a practical standpoint, and relates mostly to English practice: it is primarily intended for apprentices and workmen. The machines and hand tools found in a well-equipped boiler shop are described and illustrated. The various chapters treat on the production of iron and steel; testing materials; cutting and straightening plates; bending plates; bending angles; welding; flanging; punching; riveting; types of riveted joints; laying out work; and on various other subjects of value and interest to boiler makers and plate workers. Apprentices and workmen interested in this class of work will find this book to be a very useful one. It is published by Crosby Lockwood & Son, Ludgate Hill, London, England. Price not given.

The Tradesman, Chattanooga, Tenn., published on April 15th a special edition, largely devoted to the cotton-mill interests of the Southern States. The entire subject is treated in an exhaustive and comprehensive manner by both New England and Southern authorities, and the articles are illustrated by engravings of the leading mills. There is also a complete and accurate list of all the cotton-mills in the South, with full data.

The Seventh Special Report of the U. S. Commissioner of Labor, for 1894, is at hand, and is devoted to the slums of great cities. It represents a vast amount of labor performed in gathering information regarding the condition of the people who dwell in large cities, and who may be considered

the least fortunate of those who live in this country. It will be found interesting, especially to those who have to do with questions of sociology.

The "Special May Number" of *The Peterson Magazine*, besides its other attractive features, contains an article on "The American Locomotive," by Charles W. Strine. It is well illustrated, and written in a popular and very readable vein.

QUESTIONS AND ANSWERS.

Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet. We cannot undertake to answer questions in "next issue." This department is usually crowded, and questions must wait their turn to be answered. Neither can we undertake to solve mechanical or engineering problems, and send answers by mail.

(175) H. M., ——, asks: What is the best size for gears, and a speed for a tapping machine which I am making? Sizes of taps ¾-inch, 1 inch and 1¼-inch pipe tap. *A.*—Ordinarily, a ¾-inch pipe tap would be run at about 90 revolutions per minute; 1 inch, 60 revolutions; 1¼ inches, 45 revolutions; 1½ inches, 30 revolutions; 2 inches, 20 revolutions per minute.

(176) M. D. B., Westfield, N. Y., writes: Kindly inform me what will prevent Canada balsam from adhering to hot iron rollers. *A.*—We have had no experience in this line of work, and cannot answer your question. If we had known the purpose for which the rolls are used we might have been able to suggest some means for preventing the balsam from getting on the rolls.

(177) R. W. W., Tariffville, Conn., writes: I am a machinist, but I have had very little experience in steam fitting and plumbing; I now feel the want of this knowledge. I also wish to become familiar with the care of steam boilers and injectors. Please advise me what books will be useful to me. *A.*—The following books may be of service to you: "Plumbing Problems," relating to house-drainage and plumbing, published by the *Sanitary Engineer*, New York; "How to Run Engine and Boilers," by E. P. Watson, 150 Nassau street, New York; "Practice and Theory of the Injector," by S. L. Kneass, published by John Wiley & Sons, 53 East Tenth street, New York.

(178) A. F. W., Newcomerstown, Ohio, writes: In making grinders for corn-mills of cast-iron in small quantities, which is the best process of hardening the iron in the ladle? What mixture of pig-iron will be best to make castings that will break white, for such purposes as bells, plow points and grinders for corn-mills? *A.*—This question was referred to Mr. W. J. Keep, who says: To produce a chilling iron the silicon must be kept lower than is desirable for machinery castings. In the charges that are to be put into chilled castings leave out the soft irons. You can procure irons made from Lake Superior ore that will be more likely to give a chill. It is probable that you make the castings you name, with hard surface, against an iron chill. Any iron with low silicon will produce a chilled surface if run against an iron mold. A piece of ferro-manganese the size of an egg, or, better, in small pieces, placed in a 50-pound ladle before being filled with iron will harden the chilled surface.

(179) H. M. E., ——, asks: What is the best method of hardening, tempering and bluing small steel springs? He incloses samples which are made of thin sheet steel. *A.*—The best method depends largely upon the quantities of these springs which are to be hardened at one time, and upon whether they are to be hardened all over or only partially. If only part of each spring is to be hardened, it can best be done perhaps in a lead bath, but if they are to be hardened all over they should be put in a muffle, or into pieces of wrought-iron pipe sealed with clay, and the whole brought up to a hardening heat. This pipe can then be held over the quenching bath and opened, allowing the springs to fall into it. To blue them they must be scoured or polished bright, and then brought to the proper degree of heat, which can be done in almost any convenient way, a good way for such pieces being to put them in dry, clean sand, in a suitable sheet-iron vessel with a handle, and shake them over a fire until the proper color is obtained.

(180) F. D., Philadelphia, Pa., writes: In regard to the fraction $\frac{W}{g}$, which is called "mass," is not the weight of any given substance always the same, whether it be at, under, or above the surface of the earth, provided it be weighed by a *lever* balance and not by spring scales? The spring scales is, generally speaking, a *force*-measuring device and the lever balance a *mass*-measuring instrument. Is not this so? *A.*—Any two masses that balance over a lever at the surface of the earth will balance anywhere (effects of air, magnetism, etc., neglected), but the weight is directly proportional to the attraction of gravity, so that the spring would measure the weights correctly, *weight* being the name given to the attraction of gravity on a given mass,

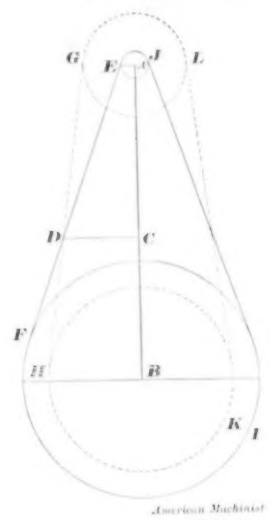
$$\text{or } \frac{W}{g} = M \text{ and } W = g\,M.$$

One-half ounce (very closely) acting for one second upon a free mass equal to that contained in a standard pound of matter, will give it a velocity of one foot per second, and will cause it to pass over ½ foot in the first second. It can hardly be said that the lever is a mass-*measuring* instrument, it is rather a mass-*comparing* device.

(181) M. L., Brooklyn, N. Y., asks: Does the patent log of a ship indicate the speed of the vessel when running against a current, or does it indicate the difference between the two speeds? *A.*—The log indicates the speed of the vessel plus the velocity of the current. To get the speed of the vessel, the velocity of the current must be deducted from the speed shown by the log. 2. In using petroleum in a boiler for the prevention of scale, can the hydrogen, which may be liberated in any manner, become ignited without any outside agencies acting upon it, and thus cause an explosion of the boiler? *A.*—No. But explosions may result from the use of crude petroleum, if not used cautiously; this oil is very heavy, and when mixed with mud will form a paste, and if this settles on the crown sheet of a boiler, the sheet may be burned, which may cause a serious explosion. The use of kerosene is much safer; there is not a sufficient body in this oil to form a paste, and it will not stick fast to the interior of a boiler. 3. How much water can be obtained from any kind of evaporator? Please give formula. *A.*—The amount of water which can be obtained from an evaporator depends on the temperature of steam, and the construction of the evaporator; a formula which will cover all cases cannot be given. For a rough approximation you may assume that one square foot of heating surface will evaporate 1½ pounds of water per hour.

(182) H. P., Philadelphia, Pa., asks: What acids are used for nickel plating, how are they mixed and how is nickel plating done? *A.*—The following method is one of several used: Into the plating vessel, which may be of porcelain, but preferably of copper, is placed a concentrated solution of chloride of zinc; this is then diluted with from 1 to 2 volumes of water and heated to boiling. If any precipitate separates it is to be redissolved by adding a few drops of hydrochloric acid. As much powdered zinc as can be taken on the point of a knife is thrown in, by which the vessel becomes covered internally with a coating of zinc. The nickel salt—for which purpose either the chloride or sulphate may be used—is then added until the liquid is distinctly green, and the articles to be plated, previously thoroughly cleaned, are introduced, together with some zinc fragments. The boiling is continued for 15 minutes, when the coating of nickel is completed, and the process is finished. If a thicker coating be desired the operation may be repeated. Articles may also be nickel plated by the electro-plating process; for full particulars see "Complete Treatise on Electro-deposition of Metals," by Dr. George Langbein, published by Henry Carey Baird & Co., Philadelphia, Pa. 2. Can Mushet's steel be annealed, so that it can be turned and milled; if so, how is it done? *A.*—We referred this question to B. M. Jones & Co., sole representatives of this steel in this country, who reply as follows: R. Mushet's special steel can be annealed with facility by any person of common intelligence in such like things by following closely the accompanying directions which we are at all times glad to furnish. When properly annealed it may be made into milling cutters, taps and a variety of uses. Many other processes of annealing Mushet's steel have been suggested and offered to us from time to time, but we believe the following is thoroughly reliable: After the steel is forged heat it up thoroughly to a light yellow (short of burning) and bury it in hot ashes from the smithy fire or in lime, and cover over with fine ashes or sawdust, so as to exclude the air thoroughly till perfectly cold. The steel will then be annealed for turning, filing, etc., but if it is found to be hard below the surface when cut into for working, it may be necessary to anneal again before finishing.

(183) A. M., Kansas City, Kan., writes: Please give me the size of the pulley, or a formula for obtaining the same under the following conditions: The distance between the centers of the pulleys is 20 inches, the diameter of the upper pulley *E J* is 1 inch, and the diameter of the lower pulley *F I* is 16 inches; I now wish to use a pulley 7 inches in diameter in place of the 1-inch pulley, and also use the same length of belt; what should be the diameter of the lower pulley *H K*? *A.*—The diameter of this pulley you can find by a graphical method as follows: Draw the line *A B*, and make its length equal to the distance between the centers of the pulleys, 20 inches; from *A* as a center draw a circle *E J* 1 inch diameter, which will represent the 1-inch pulley, and from *B* as a center, draw a circle 16 inches diameter, which will represent the lower pulley; draw a line *E F* tangent to these circles, bisect *A B* by the perpendicular *C D*, cutting the line *E F* in the point *D*. Now, from *A* as a center, draw a circle *G L*, 7 inches diameter, and through the point *D* draw a straight line *G H*, tangent to the circle *G L*; lastly, from *B* as a center, draw



American Machinist

a circle *H K* tangent to the line *G H*, the diameter of this circle will be the diameter of the required pulley. This is not absolutely correct, but it is near enough for practical purposes. You can easily verify the result by making a drawing as large as possible of the pulleys, as shown in the accompanying sketch, and measuring the length of the respective belts shown in full and dotted lines. These lengths are easily measured by stepping off short and equal distances. If the construction is correct, both belts must contain the same number of equal distances, but since the construction is not absolutely correct, it must be expected that one belt will contain a fraction of one of these distances more than the other belt, this difference will indicate what change in the diameter of the required pulley will be necessary; the change, however, will be very slight.

(184) M. T. C., Waterville, Me., asks: What is the process of galvanizing? *A.*—The process consists simply to cover sheet-iron with a thin coating of zinc. To effect this result the iron plates are first immersed in a cleansing bath of equal parts of sulphuric or muriatic acid and water, used warm. They are then scrubbed with emery or sand to clean them thoroughly, and detach all scales, if any are left; after which they are immersed in a preparing bath of equal parts of saturated solution of chloride of zinc and chloride of ammonium, from which bath they are directly transferred to the fluid metallic bath consisting of 20 chemical equivalents of zinc to one of mercury, or, by weight, 640 pounds of zinc to 106 of mercury, to which are added 5 to 6 ounces of sodium. As soon as the iron has attained the temperature of this hot fluid bath, which is only 680° Fahr., it may be removed, and will then be found thoroughly coated with zinc. Care must be taken not to leave the plates too long immersed in this bath, as its affinity for iron is such that they may become dissolved. This is the case with thin plates of wrought-iron, which, even when ⅛ inch thick, may be dissolved in a few seconds. It is safe, therefore, to let the bath previously act on some wrought-iron, so that it dissolves a portion of it, in order to satisfy its inconveniently great affinity for this metal. 2. Will a range boiler, made of a 15-inch boiler flue, with steel heads, rust a great deal, *i. e.*, enough to weaken it to any great extent, and do you think the water from such a boiler would be very rusty? *A.*—The iron will rust and in time will weaken the boiler. The taste of the water will be affected by the rust. 3. In my range I have a water lining made of composition, it has about 3 square feet heating surface, do you think that I can warm a room 10x12 feet from it? *A.*—That depends on the construction of the building, location, air supply and special use of the room. On general principles we should say that this water back will not give satisfactory results. 4. Would you recommend cast-iron or flanged steel for heads of boilers? *A.*—Flanged steel; cast-iron should be avoided as much as possible for vessels subjected to a steam pressure. 5. Which will rust the quickest, cast-iron, wrought-iron, or steel? *A.*—If there are any imperfections in the steel it will rust the quickest. There is, however, very little data to be had on this subject, as this question does not often occur in general practice. 6. Which will cause the iron to rust the quickest, hot or cold water? *A.*—We cannot find any data which would enable us to answer this question correctly, we are inclined to believe that the difference will be so small that it need not be considered. 7. What can I put on finished brass work for locomotives, which will turn it to glossy black? I do not want a paint. *A.*—Give the articles a coat of Japan varnish, and heat them in an oven in which the temperature is about 300° Fahr., or higher. This will drive off the solvent of the gums or resins in the varnish, and the gummy residue becomes liquefied or semi-liquefied, in which state it adapts itself to all inequalities, and if the coating is thick enough, presents a uniform, glossy surface, which it retains on cooling. Varnishes are made for this purpose.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Gear Wheels, Gear Cutting. Grant; see page 352.

Forming Lathes, Mer. Mach. Tool Co., Meriden, Ct.

Milling Machs. Kempsmith Co., Milwaukee, Wis.

Cam-Milling. Machine Tool Works, Newark, N.J.

Marine Iron Works, Chicago (new catalog).

Pattern and Brand Letters. A variety of sizes and styles. Heber Wells, 157 William St., N. Y.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt St., N.Y.

Engine Castings, 1 to 6 Horse-power Vertical. The Humphrey Foundry, Bellefontaine, Ohio.

Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus, air pumps, acid blowers, filter press pumps, etc.

Gardenier's "Ready Help for Locomotive Engineers." Price by mail, $1.00.
Edward Meeks, publisher, Philadelphia.

American packing rings are in touch with the cylinder. New circular about rings and pistons. J. H. Dunbar, Youngstown, O.

Squaring and Rotary Shears, Tinsmiths' Tools, Presses and Dies for sheet metal work, are made by the Niagara Stamping and Tool Co., Buffalo, N.Y.

"Binders" for the AMERICAN MACHINIST. Two styles, the "Common Sense," as heretofore sold by us and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers with full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUBLISHING CO., 203 Broadway, New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator and making all required calculations from the diagram, also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price, $2 post paid. Published by John Wiley & Sons, 53 East Tenth street, New York.

"Modern Locomotive Construction." By J. G. A. Meyer. In this book the design and construction of all details of the locomotive and tender are considered from a practical standpoint. It contains illustrations of details made from working drawings, accompanied by plain directions for designing, and rules and tables for construction. Adapted to office and shop use. Price, $10. Published by John Wiley & Sons, 53 East Tenth street, New York.

Condenser Tube Fastenings.

An English contemporary reports that at a recent meeting of the London Association of Foremen Engineers and Draftsmen, a method of fixing condenser tubes was advocated which consists in screwing one end fast in the plate, and expanding the other end, and various data as to the tightness, ease of removal and renewal, etc., were put forth as advantages over the screwed gland device, and a closer spacing, and consequent reduction of condenser weight, etc., were claimed.

The American system of screwed gland having a collar that prevents the tube from creeping more than enough to allow for full expansion under full steam temperature, will not be superseded by the above improvement; for with our methods of manufacture the screwed ferrules or glands are turned out by the ton at very small cost by special machinery, and regular tapping and drilling tools make the expense of fitting up the tube plates a comparatively small item.

No screwed and expanded end can be removed in anything like the short time necessary to release the gland and packing system, and expanded ends are seldom sound after one insertion, even where there is little buckling due to changes of temperature as there is in all condensers.

An Improved Cane Mill.

The accompanying illustration represents an end view of the latest improvements in cane mills, by James H. Fogarty, 29 Broadway, New York. It shows a marked advance in the construction, accommodation and adjustability of the cheek pieces and their associated supporters of the rolls.

The mill here illustrated has been designed to overcome well-known difficulties experienced with such machinery, and to combine great strength, durability and efficiency.

In it the rolls are very close together, and it has the smallest width of knife-plate possible. It permits watching at any time the complete operation of cane crushing and rolling, as well as the transmission of the cane from one roll contact to the other. It freely exposes to view those parts or portions of the mill that have been heretofore necessarily kept out of sight.

The relative position of the three rolls is in view at all times, and any required adjustment of position or alteration of spaces between them can be readily effected while the mill is in full operation, and the position of the knife can be at once changed to suit new positions or adjustments, it not being necessary to even "slow down" the mill. The knife and knife-plate can be taken out and put back without disturbing the other portions of the mill. Either one or all of the rolls can be withdrawn and replaced with relatively very little expenditure of time and labor, an I-beam and trolley being all that is necessary for the work.

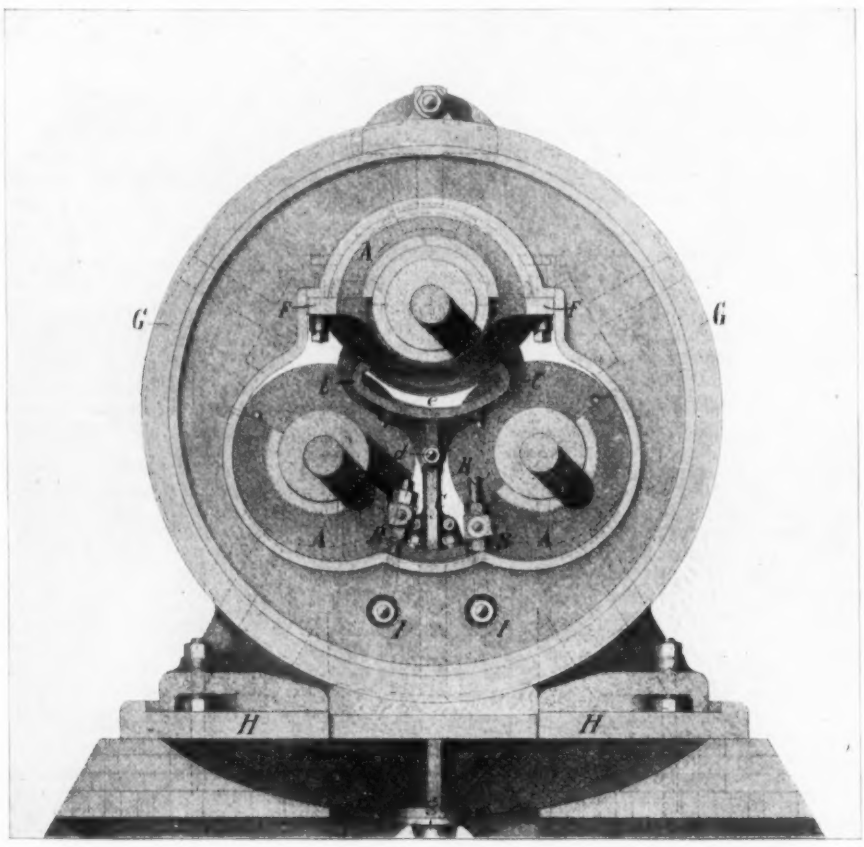
Within openings of a radius larger than that of the rolls of the mill, bearing blocks *A* are inserted, the lower pairs of which are made eccentric to the circle of shaft, to provide for their adjustment towards and from the upper roll. The adjustment and security of the lower eccentric bearing blocks is provided for by the lengthening or shortening of bolts *B*. As shown in the illustration, the lower roll to the right is adjusted to a close contact with the upper roll, while that to the left is adjusted to a moderate opening between it and the upper roll. An examination of the bolts *B* and their relative condition with reference to either bearing will explain the method of adjustment.

The portion represented at *C* is the knife and its supporting plate. Its bottom is attached to the cheek pieces, and it will rotate upon a central bolt at *d*, which bolt fastens it to a thrust supporting link *E*, open at *e* to permit of the insertion of side thrust pieces for the rolls, the cane and the liquor. The thrust supporting link *b* is fastened to and suspended from the upper shaft supporting yoke *F*, which is in turn bolted to the cheek pieces at each end of the mill. Rings *G* are made of steel or wrought-iron and are fitted to or shrunk on each side of each cheek piece to secure the cast metal in its transmission of the thrust from the crushing rolls. A shallow bed *H*, upon which the two cheek pieces are held and bolted, is constructed to receive and drain off the liquor as fast as it falls from the rolls, and it passes out through the flanged opening *g*.

Bolts *I* are centers upon which the adjusting bolts *B* swing to accommodate the variable positions of the lower bearing blocks *A*. As may be readily seen, the heavy crushing thrust coming upon the rolls is transmitted through the bearings and blocks *A* to the wide surface carrying these blocks and thence through the cast metal of the cheek pieces, radially to the rings *G*, which are made of not less than 4 inches by 4 inches steel or wrought-iron. The 28 inches by 66 inches rolls have journals 14 inches by 21 inches, the roll shaft being 15 inches diameter inside the cast metal.

This mill is designed to *express* more juice from the cane than any yet constructed. It is absolute in its pressure, there being no give or spring to any of its parts. The cheek pieces are exceptionally strong and can be used for metal rolling as well as for cane.

The gears used with this mill are made extra strong. They are 5 inches pitch of teeth on wheels of large diameter, and 4 inches pitch on wheels of small diameter.



IMPROVED CANE MILL.

Weight and Mass.

BY CHAS. T. PORTER.

The letters of "Anti-Know-All" and "Bell Crank," in issue for March 28th, indicate clearly enough the nature of the further explanations of the distinction between weight and mass that are called for, in order that this distinction shall be made clear to minds which are really and seriously interested in understanding it. Those, on the other hand, who misrepresent statements for the purpose of raising quibbling objections, it is not worth while to pay much attention to. I will endeavor to respond to this call for more light, so far at least as it seems to be addressed to me.

"Anti-Know-All" is quite right in his understanding, that a body dropped into a hole extending diametrically through the earth, and encountering a resistance, as that of the atmosphere, would finally be brought to rest at the center of the earth, where the attractions which are exerted upon it are equal in all directions. But he says: "In Professor Wood's article, in the issue of January 24th, I learned for the first time that bodies of matter attract each other only when without each other's circumferential surface, and that inside of a hollow sphere there is no such thing as weight." "Anti-Know-All" shows the possession of some extraordinary faculty, not possessed by mankind in general, in learning this from Professor Wood's article, because Professor Wood does not say so. What he does say is this: "If the earth were a homogeneous spherical shell, the hollow having the same center as that of the sphere, then a body *placed* anywhere in the hollow would weigh nothing." It will be observed that Professor Wood is not speaking of hollow bodies in general, having a free body within them, as sleigh bells, for example. He speaks only of the earth The free body within would not be acted on by any attraction except that of the "homogeneous spherical shell," and those attractions which act equally on the shell also. It is a fact easily demonstrated, and those who cannot follow the demonstration are bound to believe the united testimony of those who can do so, that a free body placed at any point within this hollow sphere would be acted on by attractive forces which are equal in all directions, and so, wherever placed, would be absolutely without weight, whatever its mass might be.

Again, "Anti-Know-All" says: "Professor Wood supposes the inside of the hollow sphere to be composed of a 'homogeneous substance,' and gives an illustration of a weight (or what would be a weight outside the sphere) attached to a cord and *put in motion* in this homogeneous substance." This cannot be regarded as anything less than an intentional misstatement, or such a degree of indifference to the truth as amounts to the same thing. Professor Wood's article does not contain the expression, "homogeneous substance," which "Anti-Know-All" pretends to quote from it. Professor Wood's expression is, "a homogeneous spherical shell"; he says nothing at all about the contents of the hollow, and his illustration of a weight put in motion by means of a cord assumes that it has no contents, but is an absolute vacuum.

"Anti-Know-All" then turns his attention to me, and professes to be puzzled by my expression, that "weight is not a quality of matter, but is only the attraction of the earth." He could not have read Professor Wood's article very attentively, for after having disposed of that article, he quotes the above expression as *another* thing that puzzles him. But in Professor Wood's article the same truth is everywhere presented, in different modes of expression and illustration, as a fundamental fact. In the following sentences, he tries to muddle the simple facts, first, that the attraction of the earth is uniform, that is, that it is the same for the same quantity of matter, and the reason why bodies differ in weight is merely because they contain different quantities of matter in the same bulk, and, second, that the resistance of the atmosphere arrests the fall of all bodies, and that in different degrees according to their weight.

On reflection, however, I withdraw the charge that "Anti-Know-All" misstates and misquotes *intentionally*, and *tries* to muddle all these things. It is evidently natural to him, and he can't help it.

I turn now with pleasure to the questions of "Bell Crank," which are conceived in a very different spirit. The mathematical expression of mass is:

$$M = \frac{W}{g}.$$

That is, the mass of a body at the surface of the earth, or at a distance, in round numbers, of 4,000 miles from its center, at which point its attractive forces are properly conceived to be gathered, is its weight, divided by the velocity per second that in falling it will acquire, or the attraction of the earth will have imparted to it at the end of one second. "Bell Crank" wants to know why it is necessary to perform this operation to find the mass. This is a very natural question, and it is one that admits of a satisfactory answer, without the use of a single mathematical expression. In fact, it is desirable, and may be regarded as essential to clearness, that in replying to this question these should be avoided.

If all bodies which are to be compared with each other, with respect to the quantity of matter they contain, were at the surface of the earth, their specific gravities alone might be sufficient for all purposes of such comparison, when this formula would not be needed. But such is not the case. It is required in astronomy that the relative mass of, or quantity of matter contained in, the sun and planets and their satellites shall be known. Now these are subject to widely different attractive forces, and themselves in turn exert widely different attractive forces.

The attractive force exerted by the sun on the planets varies as the squares of their distances. If this force on the earth be 1, then on Venus it will be 1.94, on Mars .425, on Jupiter .0363, on Saturn .011, on Uranus .0027, and on Neptune .00109—. Again the attractive forces exerted by the sun and the planets, on bodies at their surfaces, vary directly as the quantity of matter they contain, and inversely as the squares of their radii. They are as follows, that of the earth being 1: The sun 28.71, Venus .87, Mars .28, Jupiter 2.55, Saturn 1.15, Uranus .85, Neptune .80, the moon .15. These would be the weights in pounds and decimals of a pound on the surfaces of these heavenly bodies respectively, of a quantity of matter that weighs one pound on the surface of the earth. Now, if the relative masses of these bodies are to be ascertained by us, it is evident that we must get rid of the accident of their weight, that is, of the attractive forces to which they happen to be subject. Now $M = \frac{W}{g}$ is the fundamental mathematical expression by means of which all this is done. The method is to bring all bodies to the surface of the earth and compare their masses here. The process, of course, requires a mathematical education to understand, but I think "Bell Crank" will be satisfied with this answer to his question.

"Bell Crank" then proceeds to suggest this problem:

"How much centrifugal force will one pound exert at a radius of one foot, moving at a velocity of one foot per second?" I will endeavor to present the solution of this problem, and in doing so to comply with his requirement "that the complete process shall be given, and the reason for each operation in as plain and simple language as possible."

The rate of revolution is assumed to be uniform, when equal angles will represent equal divisions of time. It is important that this shall be borne in mind.

Every moving body tends to move in a straight line. A revolving body is being continually deflected from a straight line of motion. The force that produces this deflection is termed the centripetal force. It acts on the radial line, drawing the body towards the center about which it revolves. The body tends to move in a tangential direction, that is, to continue in motion in the direction in which, at every point of its revolution, it is moving. If a mechanic will tie a nut at the end of a string, say two feet long, and swing it around in a vertical plane and let go of the string just as the nut is at the top of the circle, he will observe that the nut will not fly upward in the direction it was pulling on his finger, but horizontally in the direction it was moving at the instant he let go of the string.

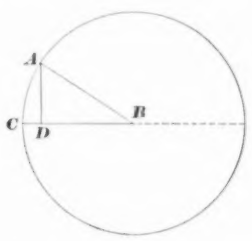
The same action will, of course, take place at any other point of the revolution. This simple experiment will, if he considers it carefully enough, tell him a good deal about centrifugal force, or the pull of the nut on the string. He will see that it is the resistance which the nut opposes to being compelled to move in a circle when it wants

to move in a straight line. By varying this experiment he will find out a number of other interesting and instructive things. For instance, if he revolves the nut twice as fast, it will pull four times as hard. If he lengthens the string and keeps the same number of revolutions in a minute, the pull will be just as much harder as the string is longer.

A revolving body is at rest, relatively to the radial line, on which the centripetal or deflecting force is exerted, for its motion is in a direction exactly at right angles to this line. So we find that centripetal force is the force required to start a body in motion from a state of rest. The centrifugal force is the resistance which the body opposes to being put in motion. These two forces are equal and opposite to each other. So it is immaterial which of these terms we use, the amount of force expressed is the same.

A force equal to its own weight at the surface of the earth, uniformly exerted, will, in one second of time, move a free body through a distance of 16.083 feet, and the distance the body will be moved in any interval of time, longer or shorter than one second, varies from this distance as the square of the time, expressed in seconds. Thus, for example, in two seconds it will be moved four times as far, in ten seconds one hundred times as far, in one-tenth of a second one one-hundredth as far, in one one-hundredth of a second one ten-thousandth as far. This is the effect produced by a force continuously exerted, such as the force of gravity, for which reason such constant force is called the accelerating force.

Now, in the case given by "Bell Crank," the radius of the circle being one foot, and the speed per second being also one foot, the time of one revolution, in seconds, will be the proportion which the circumference of



the circle bears to the radius. This is 6.283184 seconds, and in one second the body would move through this proportion of a whole revolution, or through 57.295791 degrees of the circle, for $360° \div 6.283184 = 57.295791$ degrees.

The distance which a revolving body is deflected towards the center is the versed sine of the angle. As many to whom I am requested to make this explanation plain may not know what this is, I will show it.

In the above figure, the distance *C D* is the versed sine of the angle *A B C*. The versed sines of angles, among other things, have been computed down to even one second of arc, which is one thirty-six-hundredth of a degree, but still we cannot get down to the actual amount of the deflection of the nut at the end of the string. The direction of this deflection changes at *every point*, and so the deflection is forever beginning in a new direction. The versed sine is therefore infinitely small, and cannot be expressed in figures nor conceived by the human mind.

This, however, does not prevent us from finding with certainty the amount of this deflecting force. This is the way it is done. For short arcs, the versed sine, or the deflection of the revolving body towards the center, follows the law of falling bodies, or of bodies acted on by a uniform accelerating force; that is, it increases as the square of the angle or of the time, or so nearly so, that we may, without any error, assume it to do so exactly. For example, the radius *A B* being 1, the versed sine of the angle of one degree is the decimal .000152304843609. Then, following the law of falling bodies, the versed sine of one-tenth of this angle, or of 6′, should be one one-hundredth of this amount. It is .000001523086712. You see that it follows this law exactly, until we reach the eleventh place of decimals, which is twice as far as we go in any ordinary calculation.

If, now, we multiply the versed sine of one degree by the square of the number of degrees through which the body revolves in one second, that is, by the square of the time, we shall find the distance through which the deflecting force would have moved it in one second, if this force could have been uniformly exerted in one direction. This distance is .499988 of a foot, for

$$57.295791^2 \times .0001523048 = .499988.$$

I think we may as well call this distance .5 of a foot.

Now, uniform accelerating forces vary directly as the distances through which they move the same body in a given time. So, if a body weighing one pound will be moved 16.083 feet in one second by a force of one pound, it follows that the same body will be moved .5 of a foot in the same time by a force of .031088 of a pound, for 16.083 : 1 : : .5 : .031088.

This is, therefore, the centrifugal force of one pound revolving with a velocity of one foot per second, in a circle of one foot radius. At a velocity of two feet per second in the same circle, the centrifugal force, increasing as the rate of deflection increases, which is as the square of the speed, will be four times the above amount, or .124332 of a pound.

The decimal .5 will be recognized as the versed sine of the angle of 60 degrees. In this computation it is reached nearly three degrees earlier. This is because the computation requires that the initial rate of increase in the length of the versed sine, namely, as the square of the angle, shall be regarded as continued through the full second. In fact, this rate of increase is lost, at first, as above shown, insensibly, afterwards more and more rapidly.

I think that from the above explanation, "Bell Crank" will see readily enough the answers to his questions relative to the sled on the ice.

A Feature of the Machine Tool Market.

A feature of considerable importance in the machine tool market is the recent purchase by the Pratt & Whitney Co., of all that part of the plant of the Paige Compositor Co., 1075 West Fifteenth street, Chicago, which was built by the P. & W. Co. About seventy-five machines are in the lot, aggregating in value about $30,000. The Paige Company never built more than one machine, and the tools are, therefore, practically new, and all are standard tools available for any purpose within their capacity. It is understood that the Paige Company had fully paid for the plant, and the tools were re-purchased for cash. It is said that these are now practically all the second-hand Pratt & Whitney tools there are in the market, and for a short time they will remain in place where they have been used for inspection by those who may wish to see them.

Pumping Coal.

The latest innovation in pumping, is to build pipe lines from the Pennsylvania coal regions to the seaboard, and force coal—reduced to a fine state—through the tubing, mixed with water enough to preserve a semi-fluid mass.

There is no doubt that such a method of conveyance would be successful, provided the scouring action on the tubing could be reduced to a commercial point.

In hydraulic dredges, the sand and even the softer mud pumped through the plant, cuts pumps and tubes to a serious degree, and although the sharp corners of coal particles would soon be smoothed off, so that the wear on the line would be probably mostly at the inlet end, yet the trouble and expense of renewal, and stoppages due to any break would seem to call for very careful consideration and a good deal of experiment before any very heavy outlay was entered into on the scheme.

The First Launch.

The Crescent shipyard at Elizabethport, which was a short time ago leased by Mr. Lewis Nixon, the well-known ex-naval constructor, has launched the first vessel built under the new management—a steel tank vessel owned by the Standard Oil Co.

The vessel is 150 feet long, over all, and carries 200,000 gallons of oil.

A sister boat, also for the Standard, is under way, together with a yacht by A. Cary Smith, and a twin-screw double-hull dumper.

If the price of petroleum continues to rise much higher, it may have an important bearing upon the use of oil engines, and of the various petroleum oils for industrial purposes. In many such uses the advantages gained in cleanliness, better control of heat and greater uniformity of product far outweigh all other considerations, and make relative cost, as compared with coal, a minor consideration. This feature of the case is not often fully understood or appreciated, however, by those who are considering the use of fuel gas as a substitute for coal, and thus the question of relative cost will have perhaps more influence than it should have, and more than it would have if the person deciding the matter possessed the personal experience with both forms of fuel which seems to be necessary to enable one to appreciate their relative advantages and disadvantages.

According to a press report, some sort of a miscalculation occurred in the gun shop at Washington the other day, and a ring stuck on a gun before it reached its proper position. The dispatch says: "If the ring cannot be moved, the gun will be ruined, and the Government will lose about $15,000." This would seem to be obviously true, but it is equally true that *if* almost anything else should go wrong, and could not be remedied, the gun would be ruined, and the same might be said of an engine or any other machine. But it will be very strange if the ring can neither be moved from its place nor cut off.

The question of the standardization of catalogs is attracting some attention in England, and a correspondent of *Engineering* suggests that trade catalogs be made 5″x8′, 6¼′x10″ and 10″x12½′, which is so far about the worst arrangement of sizes we have heard of. If catalogs are to be standardized in other countries, as they are in this, we suggest that they be made 4¼″x6′, 6′x9″ and 9″x12″, and that the medium size be used wherever possible. Then English, American, or other catalogs will go together in files or binders.

The latest industrial development is the fitting out of floating canning factories. A schooner has left New York having on board thousands of tin cans, and the necessary apparatus to be used in filling them. It will go to waters and lands where certain fish and fruits are to be had that are in demand here, and will there set its canning department at work to fill the cans. In this way no ice or refrigerators will be necessary, and nothing will have to be transported except what is actually useful.

Signs multiply that Keely is in need of more money, as predictions are plentiful from unknown "prominent mechanical engineers" to the effect that the moting of his motor is about to begin. A New York paper published on Easter morning an engraving of the motor. It in no way resembles those that have been previously illustrated, but might be taken for a new variety of Easter blossom.

It is claimed that in Oregon, where fuel is scarce and dear and water power comparatively plenty, it will pay to smelt iron by electricity, and it is asserted that this is done in Germany at a cost of $8 per ton.

NEW CATALOGS.

We have received a small pamphlet describing the new No. 2 Smith premier typewriter, made by the Smith Premier Typewriter Co., 293 Broadway, New York.

The Bristol Co., Waterbury, Conn., send a folder containing a complete list of a large variety of recording instruments for recording pressure, temperature and electricity. It is sent to any address upon application.

We have received from the Garden City Fan Co., corner Clinton and Washington streets, Chicago, Ill., a copy of their general catalog, illustrating and describing ventilators, exhausters, blowers, hot blast apparatus, etc.

We have received from the Union Grease Co., 39 Hartford street, Boston, Mass., a catalog setting forth the advantages and some of the methods of manufacture of lubricants for heavy machinery. It is standard size, 6″x9″.

We have received from the Marine Iron Works, Clybourn and Southport avenues, Chicago, Ill., a copy of their catalog illustrating and describing marine engines, boilers and small vessels of various types suitable for use on lakes and rivers. The catalog is well illustrated and printed, and is standard size (6″x9″).

We have received from the Wm. H. Harris Steam Engine Co., Providence, R. I., a catalog illustrating and describing the Harris-Corliss engine and the Harris patent dash pot. Aside from the descriptive matter, there is considerable general information regarding steam engineering, and the catalog will be found of interest to those who have to do with steam plants. It is 6¾″x10″.

We have received from the B. F. Sturtevant Co., Jamaica Plain Station, Boston, Mass., a catalog which is especially devoted to the Sturtevant engine, and is called "Catalog 81." In it will be found illustrations and description of automatic upright engines for electric lighting and other purposes. These are shown in various forms for driving by belt and direct connected, and the catalog is especially well gotten up, though it is 6⅝″x8⅝″.

The Felt & Tarrant Mfg. Co., 52-56 Illinois street, Chicago, Ill., send a pamphlet entitled "Mechanical Arithmetic," and in this pamphlet their Comptometer, which is a machine for performing ordinary arithmetical computations, is illustrated and described; and they also give a large number of interesting letters from concerns which have the machine in use, among these being the names of a number of firms well known to readers of this paper.

MANUFACTURING

A tin-plate plant is to be built by W. H. Griffiths, at Washington, Pa.

An iron foundry is being constructed by W. A. Nye, of Bourndale, Mass.

W. S. Harvin, of Manning, S. C., will shortly erect a $50,000 knitting-mill.

The Bennington Falls Pulp Co., of Middle Falls, N. Y., will shortly re-erect its mill.

The Metropolitan Street Railway Company, of New York City, proposes to extend its lines.

The Collier Cotton-mills, of Hickory Grove, S. C., is to erect a $100,000 plant. T. R. McDill is secretary.

The Ellis Iron Co., of St. Louis, Mo., has been incorporated with a capital of $100,000, and will soon erect a plant.

The Putman (Conn.) Foundry and Machine Works are making a number of additions to their plant in view of increased business.

Messrs. Zug & Co., of Pittsburg, Pa., will erect steel and iron-rolling-mill 100x100 feet, and will equip same with new machinery.

The Southover Land and Improvement Co., Savannah, Ga., has decided to erect a cotton-mill at an estimated cost of $200,000.

The Berlin Iron Bridge Co., of East Berlin, Conn., are building an extension to the casting shop of the Waterbury Brass Co., at Waterbury, Conn.

Prentice Bros., Worcester, Mass., are just completing an addition to their shop, 40x150 feet, two stories, iron and brick. They are driven with work.

The new foundry which the Jackson & Woodin Mfg. Co. are now building at Berwick, Pa., was designed by the Berlin Iron Bridge Co., of East Berlin, Conn.

Owing to increased business the Courtney Manufacturing Co., Greenville, S. C., is making preparations to enlarge its mills, and new machinery will be put in.

The Anderson Mfg. Co., which has recently bought the Knoxville (Tenn.) Engine and Pump Works, will enlarge the plant so as to include the manufacture of machinery.

The Facer Solid Steel Car Wheel Co., of Perth, Canada, has been formed with a capital of $320,000. The company consists of James Aubra Facer, S. C. Wilson and W. H. Churchill.

The A. K. Rarig Manufacturing Co., Columbus, Ohio, is to erect a new building 632x126 feet, and a pattern shop 250x50 feet. The company will also put in an electric lighting plant.

There is a report of an association of bar-iron manufacturers, which includes nearly all such manufacturers west of the Alleghenies. W. E. Taylor, of Youngstown, Ohio, is president.

The World Specialty Co., Detroit, Mich., write us that the international automatic injector which was illustrated in our columns a short time ago, is meeting a rapid sale and that they have difficulty in keeping up with their orders.

Later and more reliable information regarding the large hammer furnished by the Billings & Spencer Co. to the American Axe Co., of Cleveland, Ohio (mentioned last week), puts its drop at 8 feet; total hight to top of pulley, 18 feet; total weight of machine, 25,000 pounds.

The foundry of the Oakland Machine Co., of Oakland, Maine, which had been leased by the Waterman Machine Tool Co., was recently burned, and they have decided to rebuild the foundry double the capacity of the old one, with all modern improvements, to cost about $7,000. Geo. Rogers is manager of the above-named company.

The B. F. Sturtevant Co., Jamaica Plain Station, Boston, Mass., who have had a store at 91 Liberty street, New York City, for several years past, have leased the entire store and basement at 131 Liberty street, and moved May 1st to the latter address, where a full line of their blowers, exhaust fans, forges, steam engines, hot blast heating and ventilating apparatus, steam fans and appurtenances will be kept in stock for prompt shipment.

Mr. Henry Marx, who for the past year has been the New York representative of the G. A. Gray Co., has placed the New York business of that company in the hands of J. J. McCabe, 14 Dey street, New York, who will from this on handle no other planer. Mr. Marx states that he has accomplished the object of his firm in coming to New York, and has the business here in very satisfactory shape. He will hereafter make his headquarters at the home office in Cincinnati, but will be in New York frequently.

Machinists' Supplies and Iron.

New York, April 27, 1895.

Iron—American Pig—We quote standard brands, $12 to $12.50 for No. 1; $10.75 to $11.25 for No. 2; and $10.25 to $10.50 for No. 2 Plain. Southern brands, $11.25 to $11.50 for No. 1; $10.50 to $11 for No. 2; $10.25 to $10.50 for No. 3; $10.75 to $11 for No. 1 soft; $10.25 to $10.50 for No. 2 soft; and Foundry No. 4. $9.75 to $10.

Antimony—The market remains unchanged. We quote L. X., 8¼c. to 8¾c.; Cookson's, 8½c. to 8¾c.; Hallett's, 7.10c. to 7.15c; U. S. French Star, 7¾c., and Japanese, 7c.

Lard Oil—Prime City we quote at 54c. to 55c.

Copper—The market is firm, and holders do not seem to press sales. Lake Copper is quoted at 9¾c. by some of the leading companies, but it may be bought at 9.60c. from the smaller producers, or second-hand dealers. The demand for Casting Copper is good, quotations are 9½c. to 9¼c.

Lead—The market is quiet, and a fair business has been done. We quote 3.07½c. for New York delivery.

Spelter—The market is dull, very little has been done outside of a routine type. For New York delivery 3.25c. to 3.30c. is quoted.

Tin—The market is fairly active, and the demands of consumers have reached quite liberal proportions. Prices have fallen to about 13.90c. to 13.95c. net cash for prompt and current month deliveries.

✻WANTED✻

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Wanted—Agents traveling and local to sell steam spec's; good commission. Mfr., 1115 State St, Erie, Pa.

Technical graduate wants position as junior draftsman; moderate salary. C. A. S., Am. Mach.

Pattern foreman on wood and metal, wants pos.; good refs. Address B., care American Machinist.

Draftsm'n (Swede), techn'l educat'n, 4 yrs' exp. on gen'l mach'y, wants pos'n. Box 179, Am. Mach.

Wanted foremanship, by one having a wide experience with general jobbing; generators, dynamos, and engines. Indicator, care Am. Machinist.

Wanted—Situation by experienced machinist and tool maker, as gen'l foreman or sup't.; best of refs. P. F. Schroder, P. O. Box 253, St. Joseph, Michigan.

Mech. draftsman wants position; shop, technical school and office practice; best testimonials. Studti, care of Weltner, 350 E. 33d St., New York.

Practical machinist and draftsman, 25 years' experience in large scale works as foreman and master mechanic, desires change; large exp. in special mach. and jigs to reduce cost. E. H. W., Am. Mach.

Graduate of leading technical school, 4 years' experience in shop, 2 years in drawing office, desires change—could invest $1,000. Address Box 175, care of American Machinist.

Wanted—A prac. iron mach., competent to act as foreman and handle men in the iron department of an agricultural mach'y manufactory. Give exp., salary and refs. Whitman Agricultural Co., St. Louis, Mo.

Wanted—Patternmaker, who is well up in his business and able to make good working drawings and reliable work, one having a knowledge of gas engine work preferred. Address "Patternmaker," American Machinist.

Wanted—Two bright young men as machinery salesmen, one for our Chicago store and one for Cincinnati; those having experience in machine tools or machinery supplies preferred. Apply to the Lodge & Davis Machine Tool Co., at Cincinnati or Chicago.

Wanted—A foreman for machine shop building machine tools of a good class; must be thoroughly acquainted with modern methods, able to get best results from workmen, a hustler and of temperate habits; none other need apply. Address, giving age, experience, whether married, references, and wages expected. Box 177, American Machinist.

Wanted—A master machinist as foreman of a marine machine shop; he must have had a large experience and practice in shops engaged in building and repairing marine engines; must be proficient in drawing and accustomed and competent to make estimates on such work; pref. would be given to a person between the ages of 30 and 45; applicants may address Master, care of Amer. Mach., giving full reply to above with refs. if practicable.,

✢ MISCELLANEOUS WANTS ✢

Advertisements will be inserted under this head at 25 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cheap 2d hd lathes & planers. S.M. York, Clev'd, O.

Calipers & Gauges. F. A. Welles, Milwaukee, Wis.

Small tools cheap. Randall, 62 N. St., Spgfield, O.

For Sale—Second-hand drill presses, engine lathes & planers. Dietz, Schumacher & Co., Cincinnati, O.

Light and fine mach'y to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

Best and cheapest Bolt Header made by C. H. Baush & Sons, Holyoke, Mass.

Bicycle Repair Outfit. Send 6 cents postage for full illus. catalog. Frasse, 17 Warren St., New York.

Wanted—A purchaser for a good key-seater, by Mitts & Merrill, 913 Tilden Street, Saginaw, Mich.

For Sale—A first-class key-seater, new. Address Mitts & Merrill, 913 Tilden St., Saginaw, Mich.

Wanted—One or two good machinists to rent shop, and take the building of special machines by contract. Apply Box 171, American Machinist.

Estimates received from makers for price on 25 to 50 each 9-inch and 12-inch screw-cutting lathes. Bertrand, Box 27, Glenridge, N. J.

Wanted—Machine and outfit complete, new or second hand, that will press coffee grounds back into artificial berries. Box 178, Am. Machinist.

Wanted—To correspond with any one in need of a first-class key-seater. Address Mitts & Merrill, No. 913 Tilden Street, Saginaw, Mich.

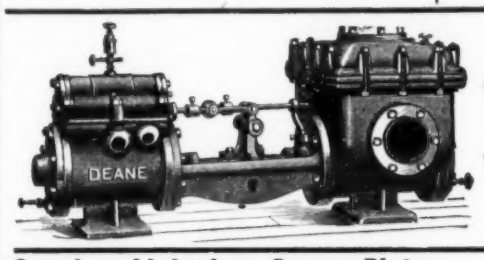
Introduction and negotiation of Americanpatents and machinery to English manufacturers and agents. Write for circular to Geo. Richards, M. I. M. E., Mechanical and Consulting Engineer, No. 5 Laurence Pountney Hill, London, England.

Wanted—The owners of a well-equipped foundry and machine shop, located within 30 minutes of New York, wish to enter into negotiations for the manufacture of specialties; also for their sale, if desired. Address, or call, 49 Wall street, Room 30, New York City.

Crescent Steel Co.

PITTSBURGH, PA.
CHICAGO, ILL.
NEW YORK, N. Y.

Crescent Extra
. . IS . .
The Steel so generally used now for Machine Shop Tools.



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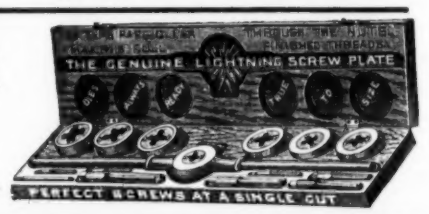
OF HOLYOKE
TANK PUMPS,
ALL STYLES.
THE DEANE STEAM PUMP CO.,
HOLYOKE, MASS.
Send for "The Deane Specialties."

Buffalo FAN SYSTEM
OF HEATING & VENTILATING
ALL LARGE BUILDINGS
BY A FORCED CIRCULATION OF WARM AIR.
BUFFALO FORGE CO.
BUFFALO, N. Y.

Genuine Lightning Screw Plates,
Taps, Dies, Reamers, Green River Screw Plates, Bolt Cutters, Drilling Machines, etc.
SEND FOR CATALOGUE.
WILEY & RUSSELL MFG. CO.,
GREENFIELD, MASS., U. S. A.



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BY
ROBT. GRIMSHAW, M. E.
18mo, Cloth, - - $2.00.
JOHN WILEY & SONS,
NEW YORK CITY.

GRANT GEARS

Ready Made Iron Gears.
Ready Made Brass Gears.
Gears Made to Order.
Gear Cutting.
1895 Gear Book, Free.
Treatise on Gears, $1.00.
GEORGE B. GRANT,
Lexington, Mass.,
and 125 South 11th St.,
Philadelphia, Pa.,
and 86 Seneca St.,
Cleveland Ohio.

"R. MUSHET'S SPECIAL STEEL"
SAVES LABOR in being able to run at GREATLY INCREASED SPEEDS. FEWER GRINDINGS. No WASTE in redressing.
SOLE REPRESENTATIVES IN THE UNITED STATES.
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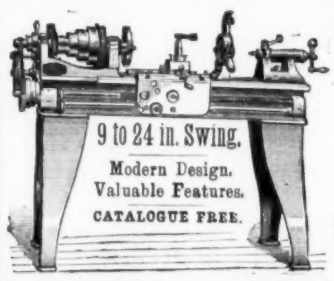
BOSTON: 11 & 13 Oliver St., NEW YORK: 143 Liberty St.

BLOW YOUR FORGES
WITH A
"STURTEVANT BLOWER."
SEND FOR CATALOGUES.
B. F. STURTEVANT CO.
BOSTON. NEW YORK. PHILADELPHIA. CHICAGO. LONDON, ENG.



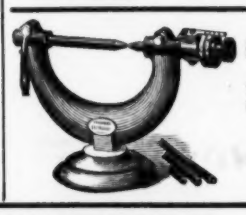
ARE YOU LOOKING
for a lathe? We are building them in various sizes from 9" to 24" swing, in various lengths, both engine and speed lathes. Our designs are the **latest**, while the **workmanship, material** and **finish** are of the **highest** order. Our catalogue will tell you all about them, as well as of our planers, shapers and other tools. A postal will bring it.
SEBASTIAN LATHE CO.,
117 and 119 Culvert St., CINCINNATI, OHIO, U. S. A.

SEND FOR CATALOGUE.
WORCESTER MACHINE SCREW CO
WORCESTER, MASS.
Manufacturers of Set, Cap & Machine Screws, Studs, etc.

QUINT'S
TURRET DRILLS
For Drilling and Tapping with from 2 to 12 Spindles.
WILL DRILL UP TO ¾-INCH.
Sensitive and Positively Driven.
A. O. QUINT, Hartford, Conn.

Place your **LIGHT RIGHT** where you want it.

Faries' Patent UNIVERSAL LAMP HOLDER.
Several styles and sizes. Ask your dealer for them or write direct to FARIES MANUF'G CO., Decatur, Ill.
Catalogue free.



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Measuring Machine
The only micrometer that will not lose its accuracy by wear.
Satisfaction Guaranteed,
SYRACUSE TWIST DRILL CO.,
Syracuse, N. Y.

THE LATEST.
OUR NEW No. 5 MILLING MACHINE
NOW READY FOR THE MARKET.
KEMPSMITH MACHINE TOOL CO.
MILWAUKEE, WIS., U. S. A.

SOFT CASTINGS,
Made from best grades of Pig Iron for Light Machinery, Electric Work, etc.
THE BURR & HOUSTON CO.,
33 TO 39 FRANKLIN ST., BROOKLYN, N. Y.

BORING AND TURNING MILLS
ARE SUPERIOR TO LATHES FOR FACE PLATE WORK.
We have a variety of sizes and a large stock for immediate shipment.
THE BULLARD MACHINE TOOL CO.,
E. P. BULLARD, Pres't. BRIDGEPORT, CONN.
New York Office, 86 LIBERTY STREET.

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ASBESTOS SECTIONAL PIPE COVERINGS.
NON-CONDUCTING COVERINGS FOR STEAM AND HOT WATER PIPES, BOILERS, ETC.
ASBESTOS BOILER COVERINGS.
H. W. JOHNS MANUFACTURING COMPANY,
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NICHOLSON FILE CO.

PROVIDENCE, R. I., U. S. A.

3000
VARIETIES FILES
[X. F.] & INCREMENT CUT FILES.

Below will be found partial list of Pratt & Whitney Co.'s machinery recently in use, a very short time, by the Paige Compositor Mfg. Co., of Chicago, Ill., some of which have not been used at all to speak of. We have purchased the entire equipment so far as pertaining to machines of our OWN make, which we offer at attractive prices. Part if not all of same can be seen in our Warehouse, S. E. Cor. Washington and Clinton Streets, Chicago, Ill.

12 16 in. Planers, 3 ft. Table.
4 16 in. " 4 "
2 20 in. " 5 "
6 20 in. " 6 "
4 No. 2½ Hand Milling Machines with Vise.
10 No. 0 Power " " " "
4 No. 1 " " " " "
4 No. 1 " " " " " and [Long Table.
1 Index Milling Machine.
6 No. 2 Upright Drills.
2 9 in. 3½ ft. Hand Lathes, Morse Taper.
3 12 in. 5 ft. " " " "
4 13 in. 6 ft. Plain Back-Geared Lathes, Power Feed, Morse Taper.
2 13 in. 6 ft. Weighted Screw Lathes, Morse Taper.
2 13 in. Gib-Screwed Lathe, Compound Rest, Morse Taper.
2 16 in. 8 ft. Bed, Plain Back-Geared, Power Feed Lathes.
2 16 in. Weighted Screw Lathe.
2 16 in. 7 ft. Gib-Screwed Lathe.
2 16 in. 8 ft. " " "
2 16 in. 9 ft. " " "
4 9 in. Pillar Shapers, without Vise.
4 9 in. " " with Vise.
4 14 in. " " without Vise.
4 14 in. " " with Vise.
2 No. 1 Screw Machine, Wire Feed.
3 No. 2½ " " " "
1 No. 3 " " " "
1 14 in. Chucking Machine.

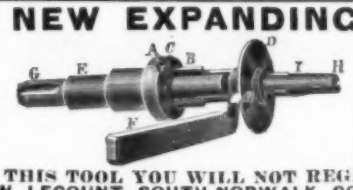
PRATT & WHITNEY CO.

HARTFORD, CONN.

Branches: BOSTON. NEW YORK. CHICAGO.

LECOUNT'S NEW EXPANDING MANDREL.

Amateur's Size.
Taking anything from ⅛ to 1 inch inclusive.
Price.....$5.00
Patented Dec. 25, 1877.



Machinist's Size.

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1	⅛ to 1 in.	$10
2	1 " 1½ "	14
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4 (with screws)	2 " 3 "	32
5 "	3 " 4 "	44

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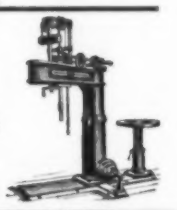

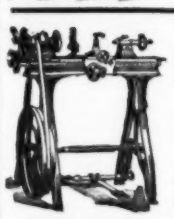

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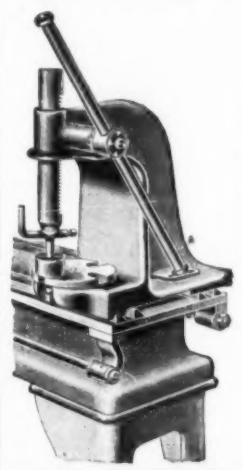

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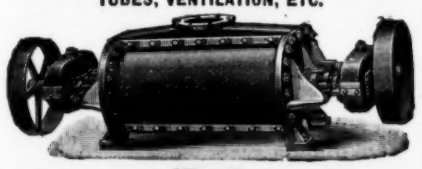

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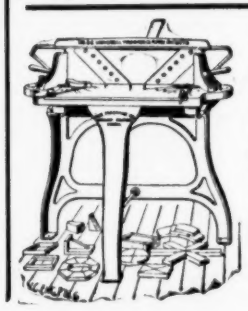

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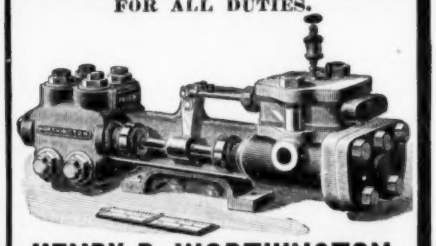

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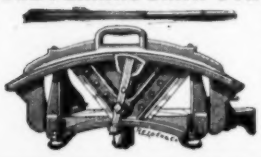

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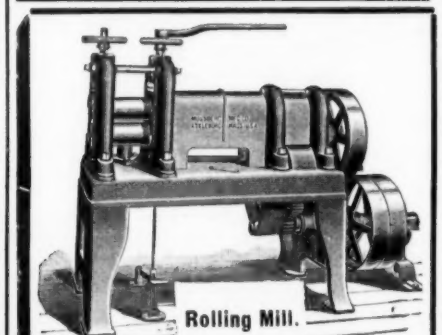

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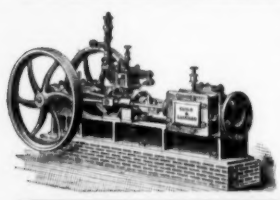

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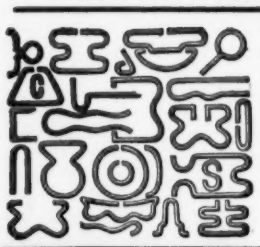

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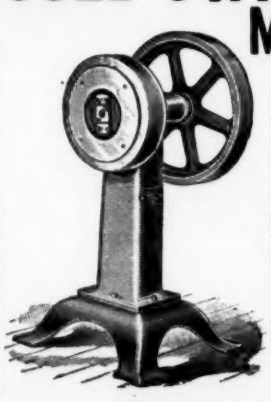

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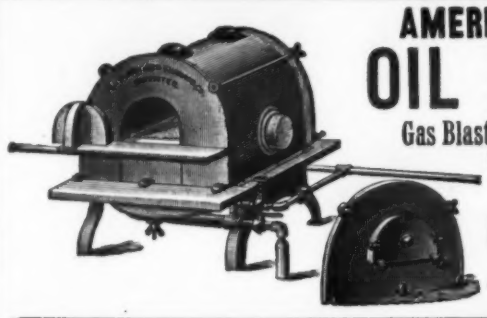

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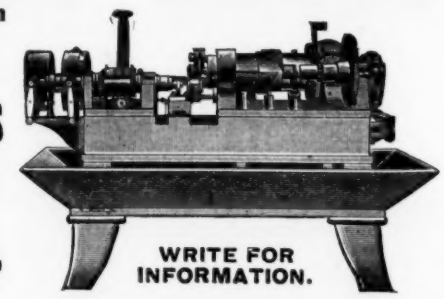

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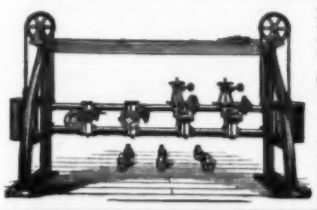

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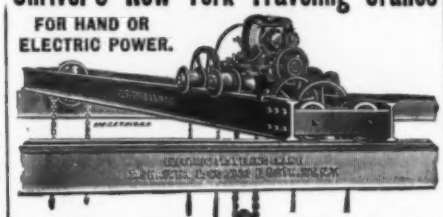

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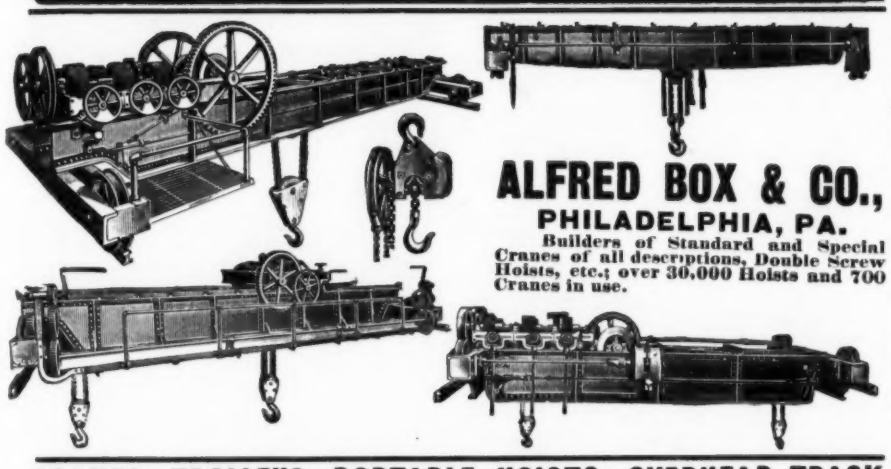

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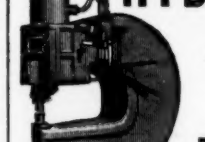

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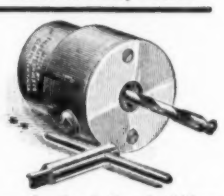

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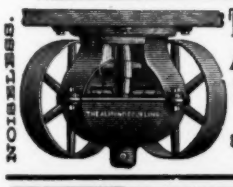

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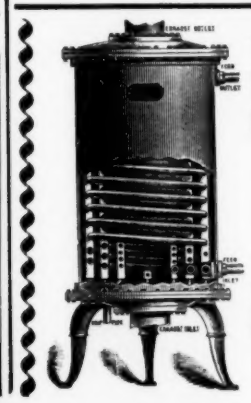

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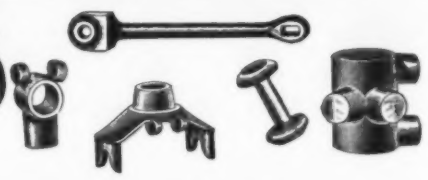

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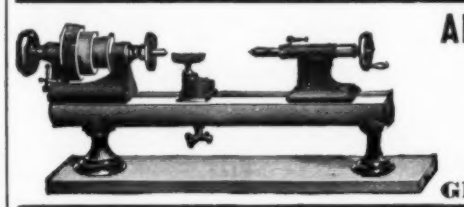

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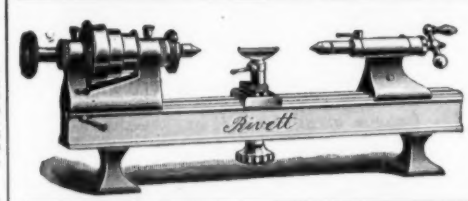

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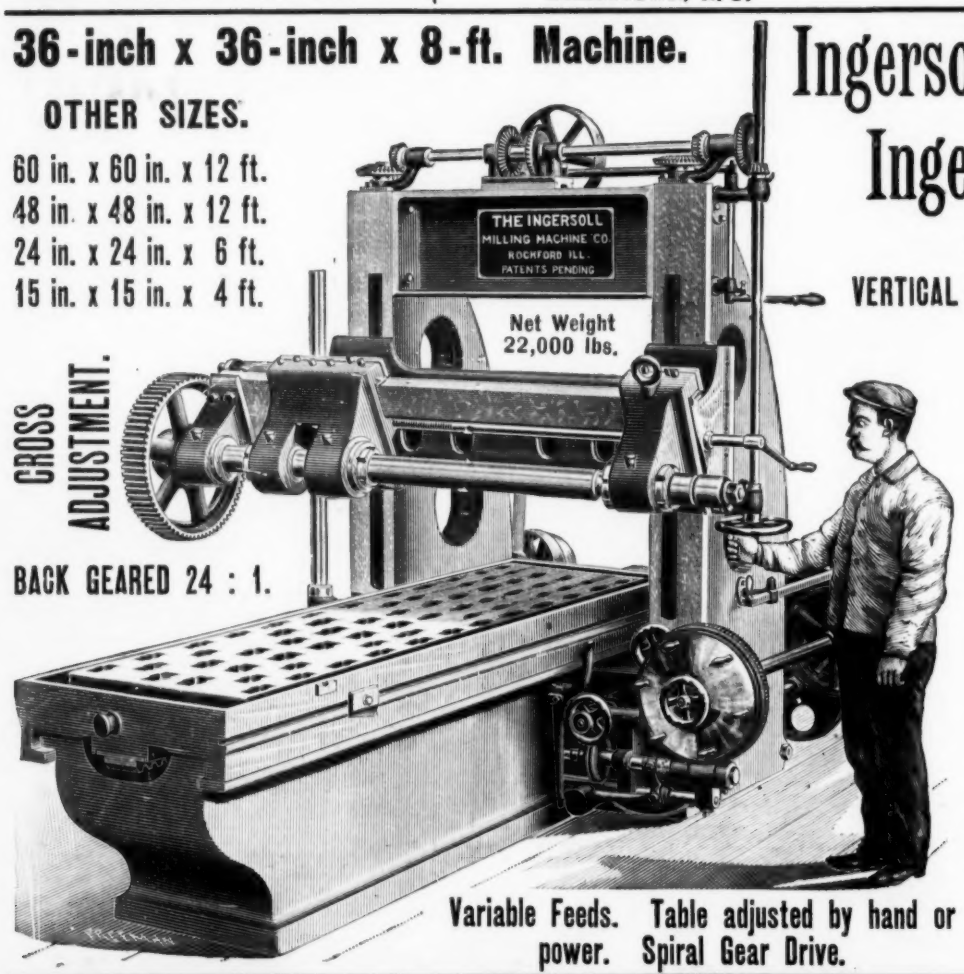

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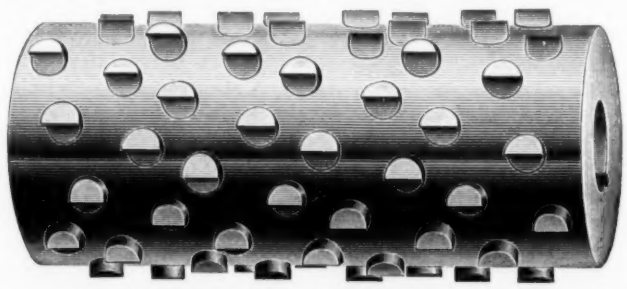

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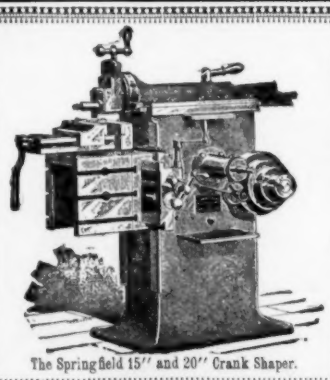

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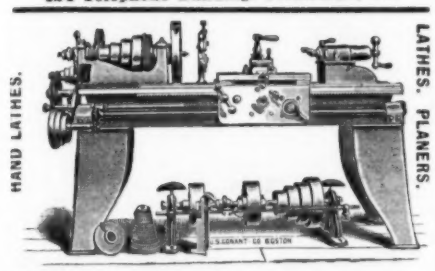

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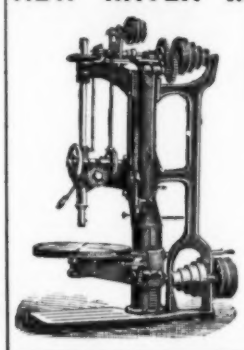

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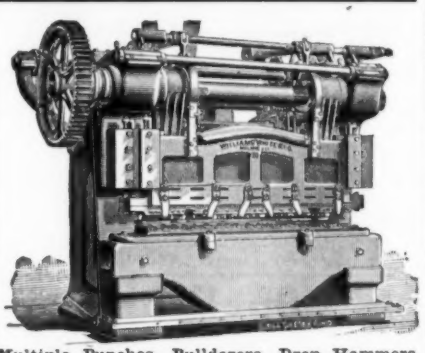

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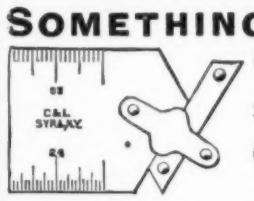

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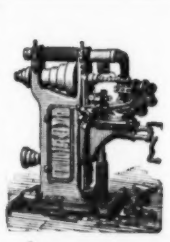

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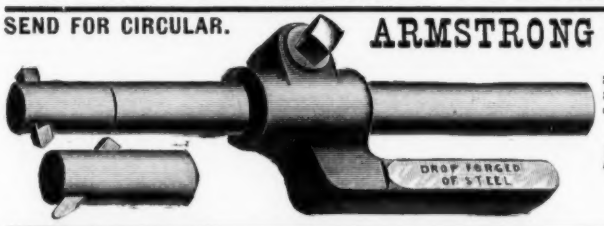

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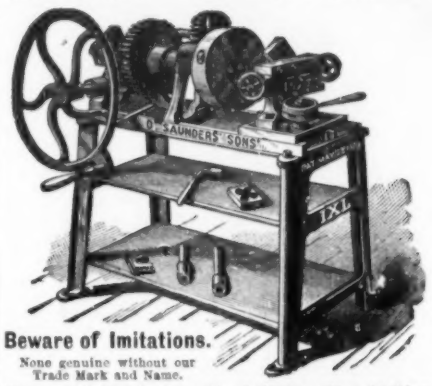

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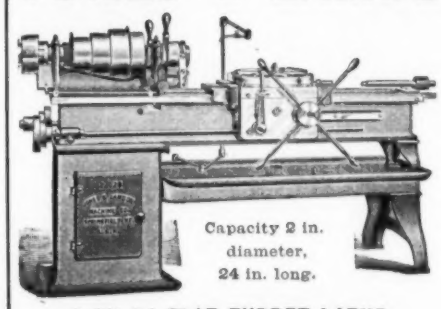

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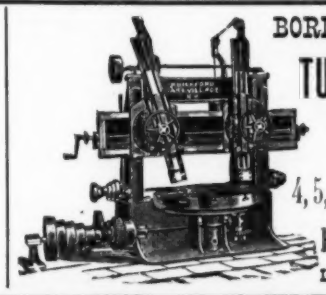

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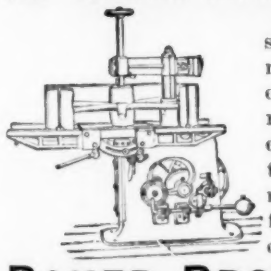

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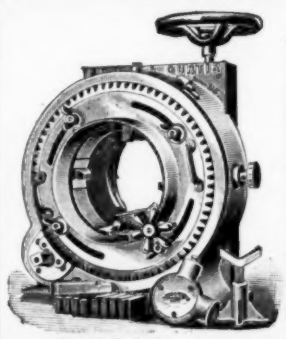

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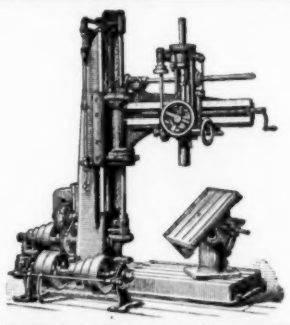

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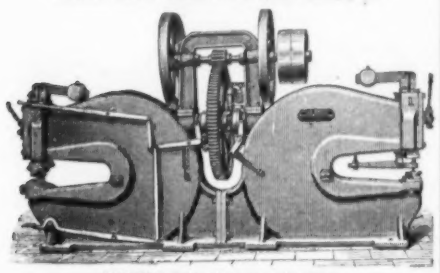

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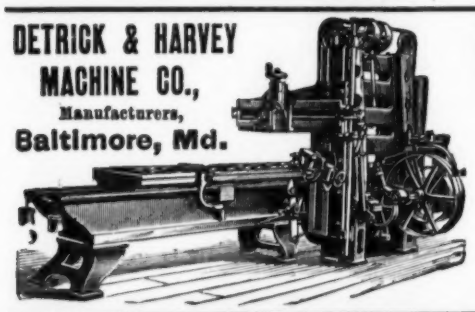

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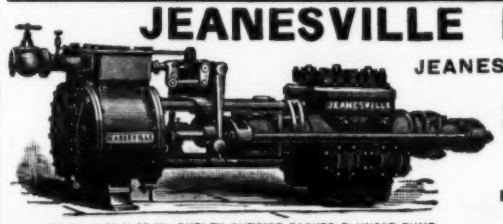

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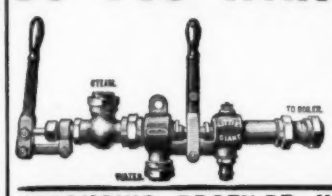

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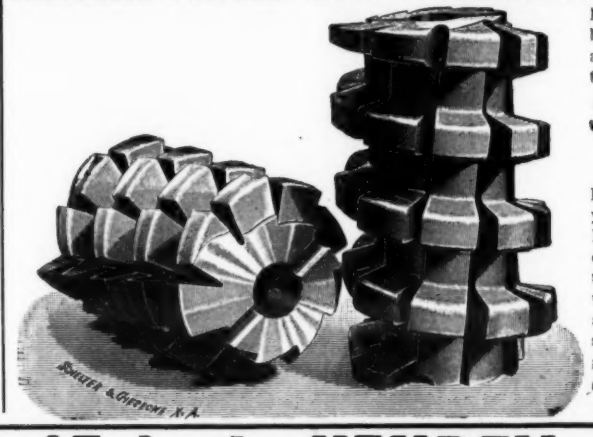

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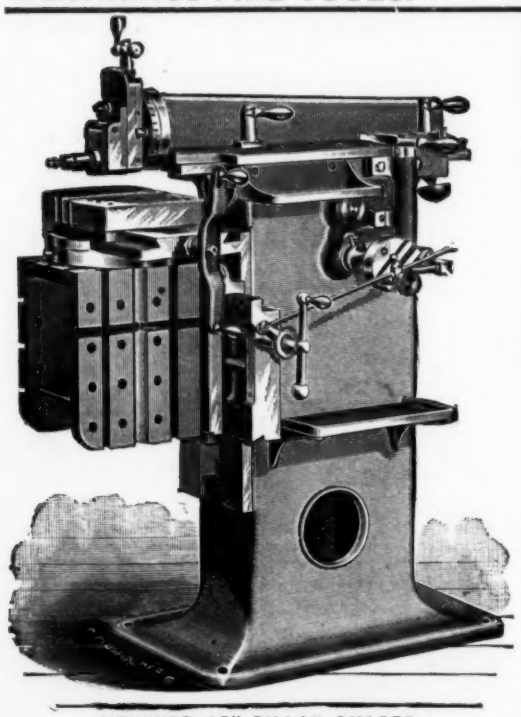

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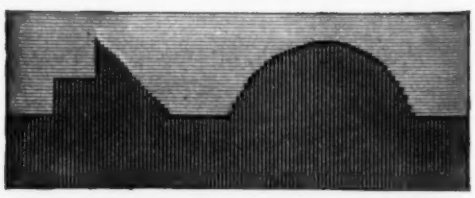

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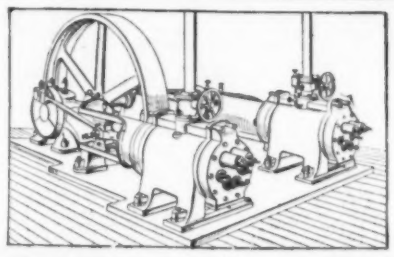

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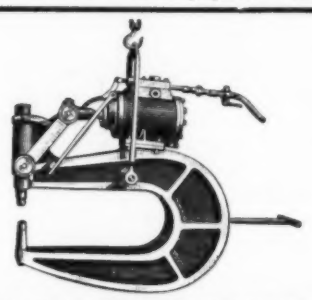

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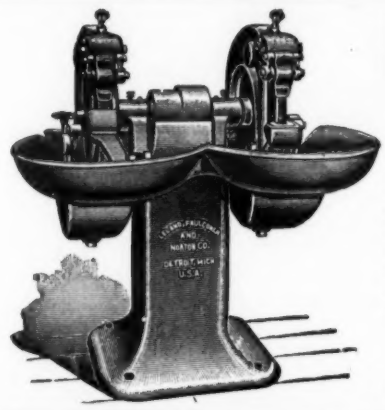

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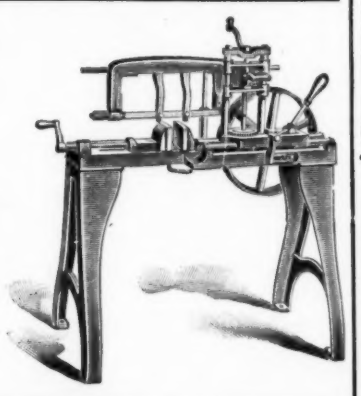

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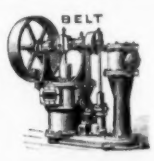

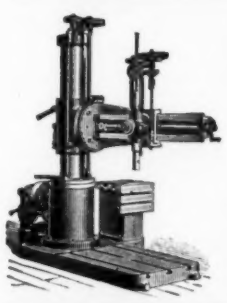

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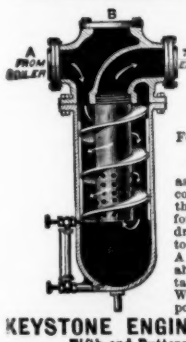

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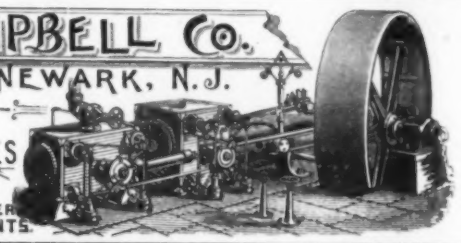

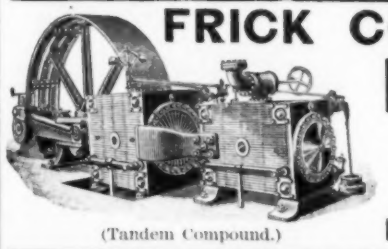

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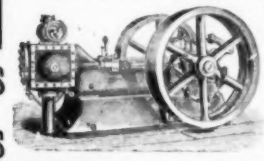

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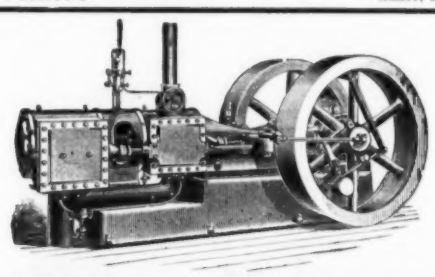

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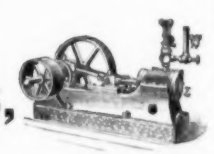

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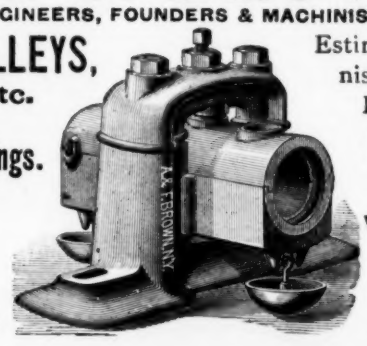

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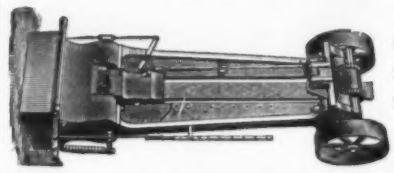

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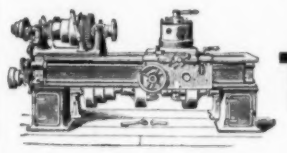

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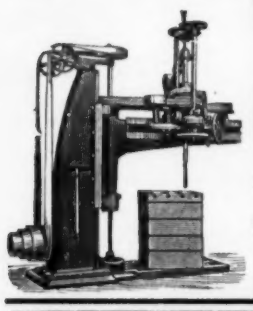

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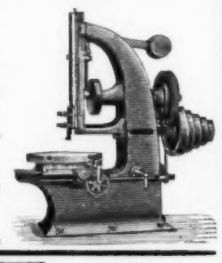

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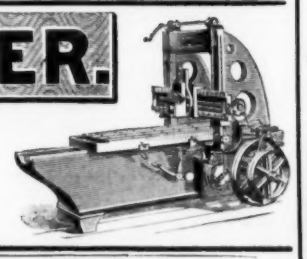

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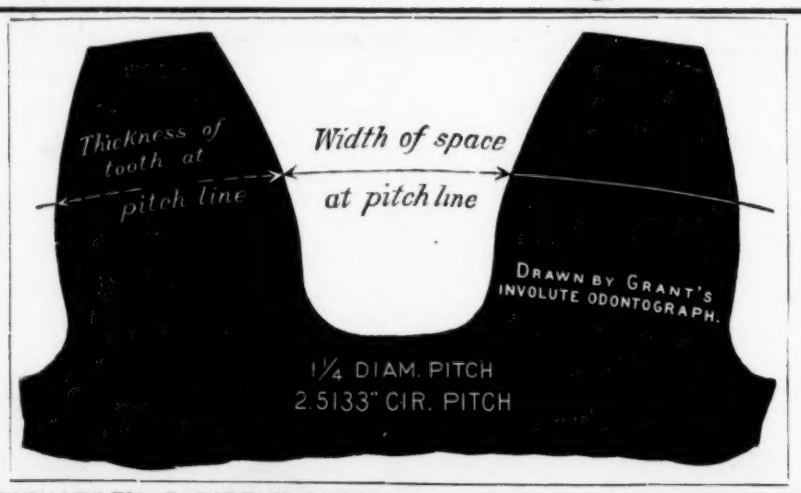
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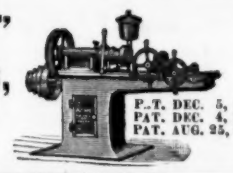

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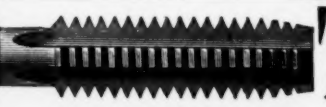

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